NATIONAL PETROLEUM NEWS

April 4, 1945

TECHNOLOGY DEPT.

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DETROIT

COL. G. H. VOGEL—Army Man and Head of Army's Oil Men

By Warren C. Platt

NAPLES, Italy—This is the man who has put together, despite the handicaps that a vast war area and its many armies introduce, the petroleum supply machinery of this Mediterranean theater. He has done it not just for the U. S. Army but for the armies of the British, the French, the Italians, Brazilians and all others who are now fighting for the Allies. (*Another Platt report starts on p. 4*)

He is not an oil man, though in his youth he started to study oil geology. He got an appointment to West Point, graduated in 1920 and became an Army man instead of an oil man. But he has had many jobs for the Army of an exceedingly practical nature in the business world, especially in the automotive field. There he studied scientific consumption and use of petroleum products and, in the Transportation Section of the Army, he studied such consumption on an ever increasing scale.

One may well conclude that he benefitted from these contacts from looking at the organization and management job he has done these past three years on military oil supply. He has a close-knit control over the oil situation even though the Army did not give him a cohesive and all inclusive authority. This Army man has, however, built up a good oil management machine because of his persistence, his drive, his persuasiveness and because he saw and developed a sound idea on which to build.

Pioneered Idea of Military Pipeline

That idea was to apply the maximum and most efficient bulk handling facilities to the movement of motor fuel for modern armies. In short, he adapted the pipeline and all its portable features, to fuel ever moving armies, rather than to use just tank cars, tank trucks and drums and cans, that call for much manpower and road space when roads are filled with advancing troops and supplies that cannot be pumped through a pipe.

This Army man pioneered the idea within Army management at Washington back in 1940. He finally won support for his request to Congress, and he appeared before the House committee to request an appropriation of $100,000 to build an experimental military portable line. He did so in 1941 before the U. S. got into the war.

He has since proved the military value of the idea because it was his oil supply organization that planned and directed and even built the many pipelines around the Mediterranean that permitted the rapid advance of the Allied troops. At times those pipelines were literally poking up into the rear lines of the armies, close enough for shelling and bombing.

You cannot be around this man's headquarters long before you find out why things move and move fast and in one direction. He doesn't run a one-man show but he certainly has been the dominating factor in oil supply while on the Mediterranean and back in England when he was there planning for the European invasion.

A lot of hard jobs are done over here and back home as well. Some of the hardest, and least appreciated, are back in the area of management of supplies and facilities. Any failure on the part of the Supply Services would make the fighting Armies helpless in these days of modern mechanical warfare.

Col. Gustave H. Vogel . . . ..."around him things move fast and in one direction."

It is hard for the public, or even the rest of the Army, properly to value a good job in the area of Army management because of its vast complexities, its millions of people and of its thousands of items of munitions. You have to get down deep into all this, as I have the past eight months over here, to understand the quality and size of the job that is being done.

I have been nearly three months in this Mediterranean area alone, all around through its present active districts up and down most of the miles of its operating pipelines, on many of its biggest dumps, at its biggest oil terminals.

Decorated by the British

From this intimate contact I say that this oil supply job here around the Mediterranean is one that the Army can well be proud of, that the American people can be thankful for because of its success and that the oil industry can appreciate and give its thanks for, because this Army man got their products when and where they were needed and in doing so did an excellent job of leadership of oil men around him so that all reflected credit upon our industry.

The British thought so well of the job he had done for the Allies that they have given him the decoration of the Most Excellent Order of the British Empire—OBE.

The oil industry, we know—as it hears of his ability from the returning members of the industry—will hail him, if it cannot give him a decoration, for his outstanding job.

The name of this Army oil man, though he insists he is still just an Army man and knows nothing about oil, is Col. Gustave H. Vogel, chief of the Petroleum Section of the Allied Force Headquarters of the Mediterranean Theater.

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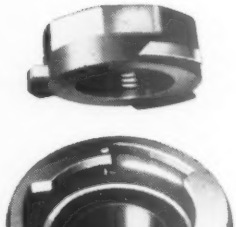

Fig. 245

All Morrison Quick Detachable Couplings are of the three lug or three point support type. This type eliminates the possibility of the coupling rocking on the lugs, causing undue wear on one point of the gasket and resultant leaks. Designed and made to withstand severe use to which such a coupling is often subjected.

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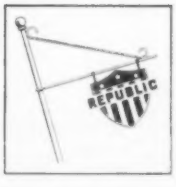

Pittsburgh, Pennsylvania

Johnson Lauds Convention-in-Print as 'Patriotic Service'; Easing Railroad Burden Helps Win War, Says ODT Chief

NPN News Bureau

WASHINGTON—In a statement to NPN and the nation's oil men, Col. J. Monroe Johnson, director of ODT, who issued orders banning conventions, this week lauded NPN's convention-in-print as a "patriotic service". (*See p. 6*)

In a statement prepared for NPN, Col. Johnson pointed out that such a plan, rather than further loading overburdened railroad facilities, removed obstacles from the free movement of troops and returning casualties, and helped the free flow of needed supplies to the front.

Col. Johnson said:

"As a transportation man, I am fully conscious that a 'convention-in-print' is not an adequate substitute for actually sitting down together and discussing, face to face, the many problems that confront the petroleum industry. As we all know, the petroleum industry is a many-sided thing; and the men engaged in the various phases of it have problems peculiar to their own groups which demand discussion and solution. In a normal year, of course, there would be many such personal assemblies, getting together in all parts of the country.

"But this is NOT a normal year. This is a war year.

"I wish I could drive home that fact to a great many people who seem to think, because we have fine armies and navies winning victories overseas, that we civilians can go blithely on our way with plans for reconversion. We at the Office of Defense Transportation know, and I believe transportation men everywhere know, that 1945—clean through to its end, whether we achieve victory in this year or later—will be the toughest year on transportation we have ever known. It may even mean that we must better the nation's transportation record for 1944. And that record of accomplishment reached heights, which, two or three years earlier, even the most optimistic transportation executive would have said were impossible of attainment.

Col. Johnson smiles approval of NPN's first Convention-in-Print issue

What the Figures Tell

"Figures tell the tale. Do you know that in 1944 American transportation handled MORE THAN A TRILLION ton-miles of freight? More than 283-billion passenger-miles? Such astronomical figures are beyond the grasp of the human mind. Yet, in terms of the ships and tanks and planes and ammunition, as well as the petroleum and other vital war commodities transported, in terms of millions of troops carried, the figures are very easily understandable. For without that transportation achievement, the forward advance of our forces towards victory would not now be possible.

"We are fighting this war, remember, by the sheer weight of metal and with the minimum loss of men. By our tremendous expenditure of metal—all of which must be carried by our transportation lines—we win victories which, in past wars were won at great expense of human lives.

"Carrying that vast load must continue until victory is completely achieved. It must not cease even though locomotives and cars and boats and barges and tank trucks wear out, break down, and must be patched together again and kept on the job. The essential materials must go through even though the manpower supply has almost reached the bottom of the barrel.

"You can all see, I believe, from what I have said, that every added ton to the nation's transportation burden retards, to just that extent, the free movement of troops and returning casualties; the free flow of needed supplies to the front. And with that in mind, you will understand that in holding a 'convention-in-print' rather than further loading the railroads' facilities by actually making trips, you are performing a patriotic service."

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NATIONAL PETROLEUM NEWS
NPN
NEWSMAGAZINE FOR OIL MANAGEMENT MEN

Byrnes' Going Away Report Heightens Hopes For Gasoline; Bad News on Fuel Oil Near

Departing War Mobilizer Is 24 Hours Behind Davies With Ration 'Relief'; More 100-Octane Plants Vetoed

NPN News Bureau

WASHINGTON—The post V-E Day outlook for American industry became clearer this week, and so did the prospects for more gasoline for the civilian motorist.

Still to seep out to the consumer level, however, was the jolting news that the home owner who heats with oil or burns kerosine can consider himself lucky if his next winter's rations are as large as those of the one past, regardless of the probable early end of the European war.

War Mobilizer James F. Byrnes supplied the pitch as to what industry (and the civilian economy) may expect after V-E Day in a report to Congress covering such varied subjects as taxes, price control, stabilization, manpower, wages, production cutbacks, transportation, small business and rationing.

Discussing the latter, Justice Byrnes held out to civilians the hope of "some increase" in the basic "A" gasoline ration—but Deputy PAW Davies had already beaten him to the punch by 24 hours.

In Los Angeles for the district A.P.I. meeting, (*See p.* 40) Davies was interviewed by the press and got "play" in newspapers the country over by saying that it was "reasonable" to look for a 50% increase in basic rations to civilian motorists when Germany drops out of the war.

PAW Elaborates

PAW, in Washington, elaborated on the Davies' statement, disclosing a present expectation that about 150,000 b/d of additional gasoline will become available for domestic consumption after V-E Day. To raise basic "A" coupon values 50%—or nine-tenths of a gal. per week—would use up approximately 80,000 bbls. of this, and the remainder would be available for trucks, to raise "B" ceilings and possibly also to ease restrictions on commercial deliveries.

It was emphasized to NPN, however, that the availability of this extra motor fuel cannot be guaranteed for a period longer than from six to nine months. This is because of the likelihood that rising Pacific war demands, resulting from a re-deployment of forces in that theater, may again force an adjustment of yields to increase the output of military fuels, particularly if there are to be large scale land operations in China. So it is possible that some of the post V-E Day increase in supplies for civilians will be snatched back by the military when Asiatic operations reach their peak.

On the fuel oil front it was a different story:

No increases are now foreseen in home-heating rations for next winter because of the anticipated additional kerosine demands in liberated European areas after V-E Day and rising navy requirements coupled with an acceleration of cat-cracking operations which will chew up additional quantities of distillate feed stocks.

An announcement was expected momentarily from PAW at NPN press time that rationing next heating season will be as strict as today despite Germany's defeat, which now, according to Justice Byrnes, may not be "too far distant."

Shapes Fuel Oil Program

OPA, in the meantime, has whipped into shape a streamlined fuel oil rationing program for next winter but is keeping mum on the details until a "green light" is received from PAW as to the supply outlook for next winter.

No radical changes will be made in rationing rules, although OPA is expected to take out its pruning shears and remove some of the present complexities. As soon as PAW says "go", OPA will launch a comprehensive publicity campaign to explain the program's details to industry and consumers.

Justice Byrnes' report was his last as director of the Office of War Mobilization and Reconversion, preceding by only two days the announcement from the White House of his resignation and impending retirement to private life.

Whether he had intended it or not, the language of his report, considered in conjunction with his surrender of a key war job, had an immediate explosive effect on Capitol Hill: It ended once and for all any chances for enactment of work-or-fight legislation. The temper of Congress was exemplified by Sen. John-

(*Continued on p.* 15)

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Bowles Denies Midwest Suits Hit 'Millions'

NPN News Bureau

CHICAGO—Chester Bowles, OPA administrator, has stated that he is disturbed to learn that a great deal of misunderstanding has arisen regarding the price violation suits recently filed by OPA here against six refiners. The confusion, Mr. Bowles said in a letter to B. L. Majewski, chairman of the Dist. 2 Distribution and Marketing Committee on March 30, resulted from a story released to the press (by the regional office of OPA) in connection with the suits, in which Mr. Bowles says he was misquoted. He said that any estimate that the suits involved "millions of dollars" was premature. (*NPN March* 14, *p.* 4)

The letter was sent to the Dist. 2 D. & M. committee chairman "because I know that you and members of the industry have been equally disturbed," Mr. Bowles said. "I am sure that you agree with me that in these suits, as in other cases where violations occur, the government must take vigorous action in the interests of the whole national stabilization program."

"Apparently the misunderstanding arises, not from the suits themselves," he said, "but chiefly from the unfortunate fact that I was misquoted in a news story released to Chicago papers. I am told that the story discussed refiners' liability in these cases in terms of 'millions of dollars.'

"Only through thorough study of the records of the companies after they have been prepared in regulation form, can the total overcharges be determined," Mr. Bowles added. That, he said, is why the "open-end" type of suit is being used.

"Furthermore," he continued, "the unfortunate impression has arisen that OPA has said or implied that all midwestern jobbers and retailers have been caught in an illegal squeeze between refiners, prices and ceilings under which the jobbers are required to sell."

Pointing out again that amounts involved will be unknown until a complete accounting has been made, Mr. Bowles said it would be impossible to tell the number of sales and customers involved and that any generalization now was unfair. The suits, he said, do not involve the contention that there has been any "squeeze" on retailers.

With Warren Platt in Italy—

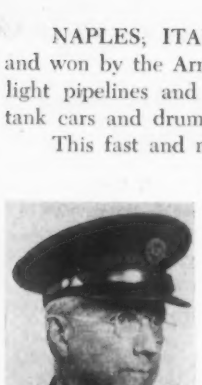
Flexibility of Pipeline and Other Oil Industry Equipment Gives Allies Decisive Edge in Mediterranean Campaigns

Supply Lines Moved and Installed Behind Advancing Armies as Part of Planned Strategy of Both the Army and Navy

By Warren C. Platt

NAPLES, ITALY—The battles around the Mediterranean are being fought and won by the Armies taking full advantage of the portability of the oil industry's light pipelines and storage tanks in addition to using the industry's tank trucks, tank cars and drums all to the utmost of their flexibility.

This fast and mobile use of oil industry equipment is planned for each attack as a part of the basic military strategy by both Army and Navy. The oil equipment is moved and installed with the advancing armies and navies, just as are the troops, artillery and armored equipment of the land forces and the fighting ships of the navies.



Mr. Platt

Because of the thoroughness of the planning and the skill of the managing of this flexibility of the oil industry's facilities, there has never been a time anywhere in the entire Mediterranean theater when a military movement was hampered, let alone halted or delayed, or a plane kept out of the air when it should fly, by any lack of petroleum products.

At 16 points where important attacks were made in this encirclement of the Mediterranean in these past two and one quarter years, the pipelines, storage tanks and supporting distributing facilities have been brought up and placed immediately behind the fighting armies so as to get the largest possible volume of fuel to the fighting internal combustion engine equipment as quickly as possible and with the least cost of manpower, trucks and traffic congestion—and that means bulk handling right up to the front as against package handling.

To do this behind all fighting fronts more than 2500 miles of pipeline have been constructed, and approximately 500 pumping stations with 250 bolted steel tanks with a total capacity of more than 1,250,000 bbls. have been installed.

In addition a few millions of barrels of old storage tanks, in oil company terminals and what is left of some refineries, have been patched up for war service.

Because of the portability of this equipment, much of it has been taken up and moved to new locations, when the fighting moved on far enough. At nine of these 16 important fighting points, this has been done. In fact, today in North Africa there is only one small pipeline eight miles long remaining out of a total of 818 miles of pipe laid in all North Africa. Much of the tankage also has been moved. That recovered pipe and tankage is now doing service in Italy.

Figures Indicate Size Of 'Med' Operations

The small lines in Sicily and Sardinia, that served airfields from which first Italy, then Southern France were bombed, have been moved to other war work. Two stretches of lines in Italy have also been taken up and moved further north right behind the fighting British and U. S. Armies.

The great size of this whole Mediterranean petroleum operation is indicated by a few more facts:

More than 117,000,000 bbls. of petroleum products have been imported to Jan. 20, 1943, to this theater since the initial invasion Nov. 8, 1942. This does not include the packaged products the armies brought in with them. Practically all of this has been for the war. What civilian products are in this figure, are insignificant in amount.

Imports to the Mediterranean have been steadily increasing as action by land and air has increased so that today imports are running around 7,000,000 bbls. a month.

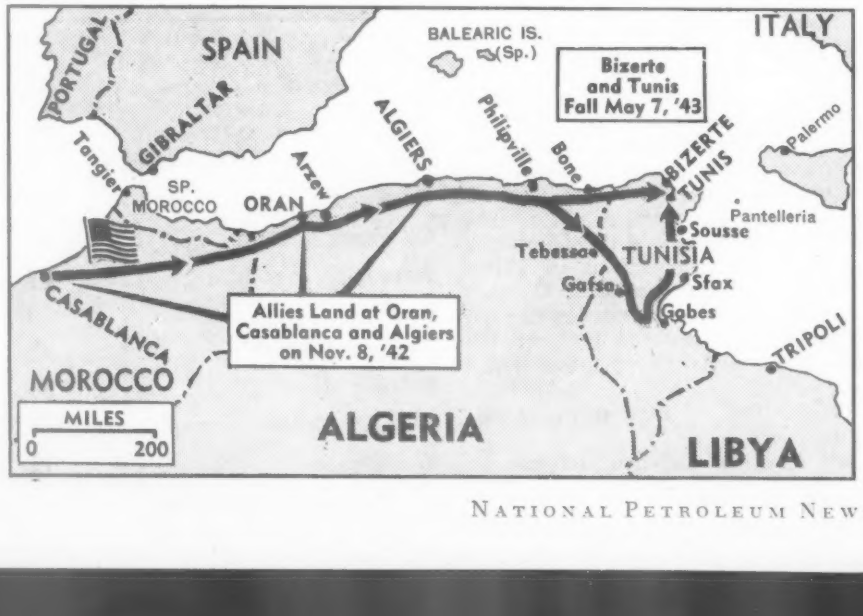
To do just the over-all job of managing the oil supplies for the theater, and exclusive of the latest pipeline run up from Southern France, PET SEC of AFHQ, which is in entire charge of this big Mediterranean oil supply job, has on its own staff 183 people. The number has been above 200 but it has been decreased as the war moved past some of the old oil centers. In addition, PET SEC has on loan from other Army and Navy units some 150 more persons who are located at various points of consumption around the Mediterranean.

For the operation and construction of pipelines and storage facilities a few months back there were 17 gasoline supply companies of 135 officers and men each, in the U. S. Army, while the British have men at 12 bulk terminal points totaling 150. There are also a number of engineer companies on construction with several hundred men and a civilian working force that runs into a few thousand depending on the day's requirements.

The size of this Mediterranean oil operation also is indicated by the fact that it maintains supplies for one of the largest if not the largest group of bomber fields in the world, those on the Foggia Plain in southeastern Italy. The only comparable group is in southeastern England. From the Foggia plain hundreds of bombers and fighter planes take off every day to drop their loads on the heart of Germany.

The Mediterranean theater of war has undoubtedly made the greatest use of the extreme mobility of oil industry distributing equipment of any war theater so far. That has been true because the campaign has run along first the northern coast of Africa and then across the islands, up Italy and then over to France, all right on or close to the coast.

Because of this, oil equipment has



been moved to first one captured port after another as the armies advanced. It was not necessary to stretch a temporary pipeline into a long permanent one as has had to be done in northern France where ports east of Cherbourg did not fall on schedule and when they were captured considerable time was required to clean them out so tankers could enter.

Because of this flexibility of oil equipment, air fields have been steadily moved eastward and then northward and kept within easy striking distance of the enemy, so there has always been a "softening up" process at work by Allied planes bombing behind the enemy's front lines, and on the next point to be attacked.

This movement was rapid.

The first attack in the Mediterranean was at Oran, Algiers, Nov. 8, 1942. Here 319 miles of line were laid and 32 tanks erected in the next few months. By Nov. 17 the troops were fighting over in Tunisia 750 miles to the east, so construction of short lines and storage in between and down inland from the ports of Arzew, Philipville and Bone was rushed.

By Nov. 28, the troops were fighting on a 250-mile front, extending south from Tunis.

By May 7, when this ended, more than 700 miles of line were laid and 29 tanks were erected from Bizerte to Tunis and south to the air fields, the last tank being finished July 30th.

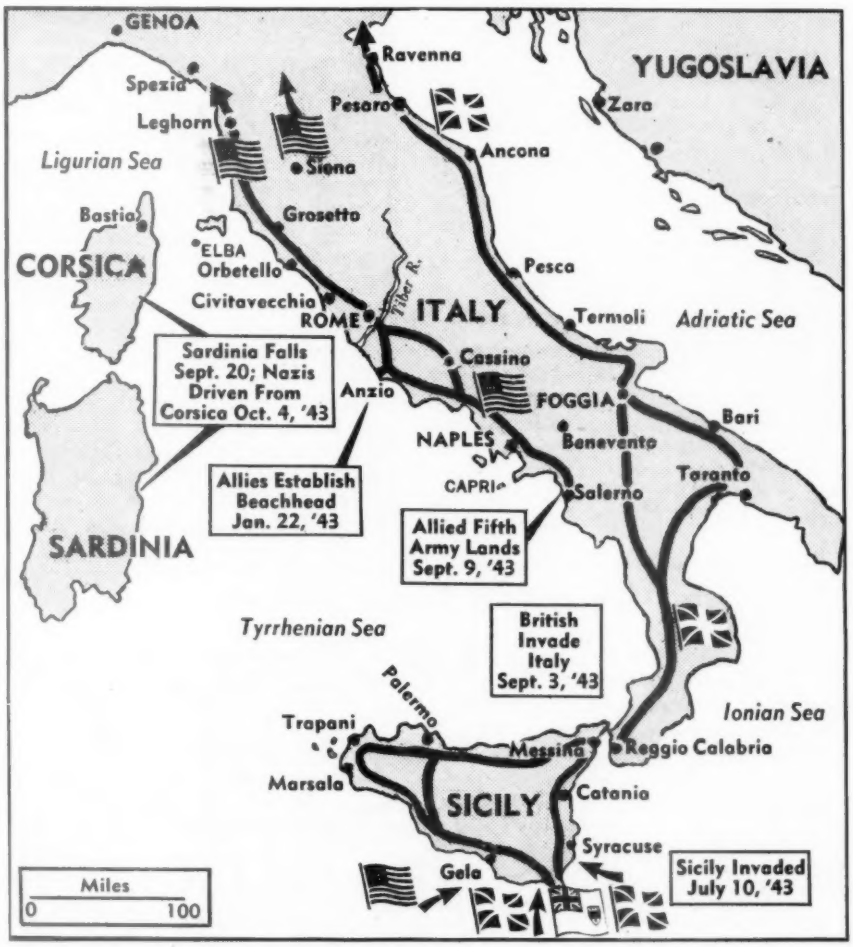
On May 8, the day after Tunis was captured, the air assault on Pantelleria, a small island between North Africa and Sicily, began. That place was captured June 11.

On July 9 assault landings were made on Sicily by reason of the construction of most of the 800 miles of pipeline in North Africa and erection of 125 tanks, mostly to supply air fields. These oil facilities also made possible in due course advance attacks on the islands and the mainland of Italy.

Sicily was captured Aug. 16 and 84 miles of line and nine tanks of 40,000 bbls. total were erected for the next advance.

Sept. 3 a landing was made at the toe of Italy.

By Sept. 20 Sardinia was taken and a short pipeline and 2,000,000 bbls. of storage erected.



Dark lines on maps, at left and above, show the routes taken in Africa, Sicily and Italy by invading Allied armies. As the armies advanced they were fueled through pipelines laid close to the front lines. When the armies moved ahead pipelines and pumping equipment were transferred to more advanced positions. Altogether about 2500 miles of pipelines were laid by the PET SECTION of the Allied forces in the "Med" campaigns, much of which has now been removed. Of the 800 miles of pipeline laid in Africa only eight miles remain. Maps should be studied with Mr. Platt's description of pipeline locations in the accompanying article

Salerno, on the mainland of Italy below Naples, was attacked on Aug. 15 and captured by Sept. 18th.

Oct. 4, Corsica was taken and in a short while 80 miles of pipeline were laid and 80,000 bbls. of tankage constructed.

Oct. 29, 1943 construction began on the main pipeline from Naples to Rome. By Jan. 3, 1944, 44 miles of line had been laid to San Felice. Construction was held up by prolonged fighting at Cassino but when that ended the 138 miles of line into Rome was completed by June 4th.

From Rome north, the line was laid as the enemy retreated towards home. This was started July 23, 1944 and completed to Siena by Sept. 1 but has since been taken up.

In May, half way to Leghorn, at Orbetello, a 90-mile line was begun and laid by July 3 behind the advancing U. S. Army. After the Army reached and passed Leghorn, this line from Orbetello was pulled up.

Sept. 28, 1943 the Allies took over the plains around Foggia.

Nov. 6, stringing of the first section of the pipeline system there was finished. From then on the laying of 651 miles of pipeline was rushed and was finished in July 1944. This line is now supplying thousands of bbls. a day of 100-octane gasoline to one of the largest groups of bomber fields in the world.

In February 1944 the British began laying their 100-mile line from Ancona on the Adriatic up behind their 8th Army.

Only Bulk Handling of Fuel Could Have Done the Job

Last fall, when southern France was invaded, it was with the support of planes flying from the islands and from Italy and North Africa. As the enemy was driven north up the Rhone River valley a pipeline was started that today serves not only the invading army but other armies that are crowding across the German border north of Switzerland.

Nothing less than bulk handling of motor and airplane fuel could have supplied all these invasions and kept them going in view of their size. While cans and drums necessarily were the first containers of motor fuel landed on each invasion, they made huge piles on beaches and at dumps and required the services of many hundreds of men, as well as offering excellent targets for bombing raids and fire.

These were large armies that landed, even on the first few days. In the first day of the North African invasion all three task forces landed a total of more than 100,000 men with 9000 vehicles. These figures were almost doubled in a week's time until at the end of 42

(*Continued on p.* 16)

NPN Oil Marketer's Convention-in-Print

Service Performance of Lubes and Greases Vastly Improved During War, Larson Says

The third session of NPN's Oil Marketers Convention-in-Print was called to order by Chairman Herb Taylor in these words:

LADIES AND GENTLEMEN: At the opening session you were told there would never be a dull moment. Judging by the nice things oil men throughout the nation have told us since sessions one and two, we feel that we have kept our promise.

As one of those attending told us: "This is one convention where you can slip out, if you feel like it, without having every so-and-so present turning around and giving you a dirty look." And this gentleman very kindly added that so far he has had no hankering to leave.

THIRD SESSION

There have been very few oil marketing conventions that did not have as one of its features a talk by a distinguished petroleum technical man. Just between us girls—and I may be wrong—these brilliant men in a great many cases talked right over the heads of most of those attending. This despite wise and knowing nods by the listeners when these molecule pushers emphasized their points by slinging out a batch of $64-words.

This session is going to be different.

It is true that our guest speaker is a noted engineer. It is also a fact that he is a writer of many scientific and technical papers—including many in NPN's technical publications.

But our speaker, C. M. Larson, has captured that something that enables him to talk the language of the oil marketer, the sales manager, and the sales department.

Maybe it's because he has a sense of balance.

While his home is in the East—New Rochelle, N. Y., and his operations emanate from a New York skyscraper—he is also a farmer. Not one of those fancy kind either. Back in the hills of the Ozarks in Missouri, he has a real farm. There he raises plain ordinary hogs. He specializes in sheep, registered Jersey cows, and other things far removed from petroleum.

Mr. Larson is Chief Consulting Engineer and Chairman of the Sinclair Products Committee. He is past vice president of Fuels and Lubricants Activity of the S.A.E. He is Chairman of Committee D-2s Technical Committee B, of the American Society for Testing Materials.

He is a member of the American Society of Mechanical Engineers, Institute of Aeronautical Sciences, Naval Engineers, and A.P.I. Many of his papers on fuels and lubricants have been published.

Mr. Larson is now Consultant to the Treasury Procurement Section on Greases and Cutting Fluids. At the beginning of this war, he acted in the capacity of expert consultant to the Secretary of War.

In World War I as a young engineer, he wore first lieutenant's bars in the air service of the Army. Even then he was specializing in lubrication, being in the wing lubrication section.

I know you will like Mr. Larson's talk. It gives an insight into a big question on the minds of marketers looking to the future on what the postwar picture of lubricants and petroleum products looks like today. Mr. Larson.

Lubricants Keep Pace With Varied Engine Improvements

MR. LARSON—Never before in the history of the United States have the motive power plants of our transportation systems taken on such new forms. The steam locomotive now appears powered with a steam turbine instead of a reciprocating engine with cylinders; Diesel locomotives of 6000 horsepower are not uncommon; gas turbines are on the horizons, and jet propulsion aircraft is a fact. Just imagine what the automotive engineer has up his sleeve for the postwar car, truck and bus, not to mention the civilian airplane or skyroad car that will appear in the next five years.

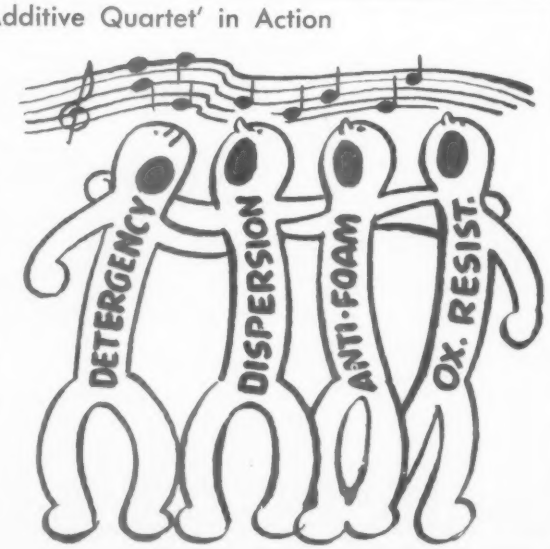
But while this evolution in power plants has been taking form, the petroleum industry's development in lubricants have made great improvements in motor oils, aircraft engine oils, gear lubricants, chassis and wheel bearing greases, hydraulic fluids, and rust preventives, as well as chemical additives for each and every lubricant.

The chemical composition and chemical changes brought about by service performance of these lubricants are much more important than the old physical standards of prewar days. Service performance standards are those gauged by engine or weather tests where oil without a pedigree has little standing. It is true that the war has accelerated these benefits, as necessity is still the mother of invention, in spite of the fact that it is the hard way.

All these new concepts will affect your Association and your sales outlets. The transition will require caution and need for study of the problems ahead. Just consider the millions of cars that are operating on low daily mileage being

The 'Additive Quartet' in Action

Working together in harmony, members of the Additive Quartet combine their various helpful properties to keep engines running "sweet as a song." "Detergency" removes deposits from the engine walls and "Dispersion" keeps them in suspension so they don't clog the filter screen. "Oxidation Resistance" prevents harmful oxidation of the oil, while "Anti Foaming" keeps the oil at its true level.



released by victory in Europe, to hit the highway at high speeds and long runs. The bearings worn paper thin have a very low factor of safety; the cold engine sludge is set free by the hot oil of high speeds — this sludge clogging the oil screen and the oil circulation. Just think what your oil will be blamed for when the problem is not oil quality, but maintenance and overhaul.

Think of the nomenclature that our veteran soldiers from overseas will have as most of the motor oils and gear oils are of the additive types. Will you be asked, "Has your motor oil any 'adjectives' in it?", as has been asked by men with a "little knowledge". Surely the petroleum industry is one strongly entrenched behind chemicals, whether it likes it or not.

MOTOR OILS

As ever, the motor oil demand of the passenger car, trucks and buses are your first concern. At present the passenger car engine and transmission are more or less on a straight mineral oil basis by directive, whereas the trucks and buses are more and more going over to additive type oils. The heavy duty or HD motor oils used by the armed forces in all gasoline and Diesel powered engines of the ground forces, in many cases, are too potent and act too much like a purge. Thus a new line—one without a name as yet—an all purpose motor oil that, as a postwar lubricant, will fit the 85% of your market, both for passenger car and for trucks less than 1½ ton capacity. Thus there will be straight mineral motor oils, heavy duty motor oils and all-purpose, much like you had with gear lubricants—mineral, hypoid and E.P. grades.

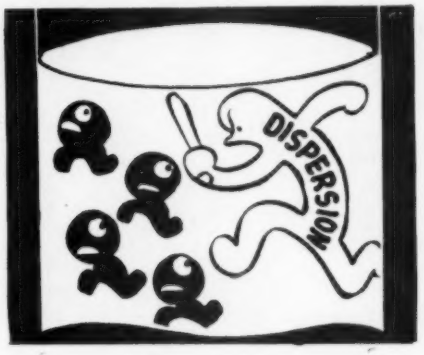
The amount of chemicals and the composition of these motor oils will depend upon the equipment, both present and future design, the operator and maintenance of the vehicle. That, however, is a matter for the oil technician. However, what you will probably want to know is what the ingredients in the motor oil do and how they work. The successful performance of these motor oils service depends on four actions which are known as: "DETERGENCY, DISPERSION, OXIDATION RESISTANCE and ANTI-FOAMING."

DETERGENCY — Detergency is the cleaning or purging of foreign material so that in a motor oil the magnitude of this characteristic is dependent upon the engine's ability to produce soot or carbon or decomposition products which stick to the engine parts. Detergency is very desirable to remove engine deposits and keep engines clean. While straight mineral oils have varying degrees of detergency these values are inadequate for most modern and postwar engine operations. Suitable chemical additives or soaps are used to increase detergency, as conditions warrant. As deposits are formed on engine parts, they are purged or dissolved and taken into the oil by such detergents. As these deposit-forming materials become part of the oil they are removed when draining the crankcase.

Therefore, detergency as related to a motor oil is that property which prevents initial deposition of products produced by combustion, oil decomposition, and by deterioration of the oil in new or clean engines. It also exerts a cleansing or dissolving action on former deposits in all parts of the engines. The highest detergency factor is usually found in heavy duty types of motor oils. Caution should be taken to remove oil frequently in first use of such oils in engines having medium or heavy deposits and in many instances of such loosened deposits sufficient to stop oil flow.

C. M. Larson . . . Chief Consulting Engineer and Chairman Sinclair Products Committee

DISPERSION — The extent to which the deposit is broken up and the degree to which such finely divided particles of deposits can remain suspended in the crankcase oil, is the dispersion factor of the motor oil. Dispersion is inter-related with detergency but is the agency which decides whether "coffee ground sludge" forms or that desired finely-divided colloidal phase. The latter keeps the sludge from forming in the crankcase and allows the washings to be completely drained from the crankcase. Thus the laundrying of the engine's working parts and crankcase is complete.



OXIDATION RESISTANCE — Motor oils subjected to moderate crankcase oil temperatures for long periods of time or for high temperatures for short periods, oxidize to a great extent. The oxidized products may form corrosive acids that are very detrimental to copper lead or other alloy bearings, causing complete failure of such bearings, or as viscosity increases of 20 to 200% are formed by oxidation so that the motor oil circulation is impaired; or as varnish which deposits as a lacquer on the piston, valve stem or overhead valve mechanism, affecting the engine operation; or as a heavy coagulated sludge which settles over the engine, especially in the crankcase. This characteristic of a motor oil, its resistance to oxidation, is really of first importance. The more oxidation resistance a motor oil has the less chemical detergency is needed, as there are far less deposits to wash off or dispose of so that the engine is better lubricated. By improving the oxidation resistance of the straight mineral oil through the use of chemical inhibitors, the oil's ability to resist corrosion, varnish or lacquer-like deposits, thickening of the oil and oxidized oil sludge deposits, are improved.

ANTI-FOAMING — The tendency of detergency additive type motor oils to foam has brought into being anti-foaming additives. This foaming is similar to that which occurs when soap is added to water. The soap changes the surface tension properties of the water so it retains air. The chemical detergency and

(*Continued on p. 52*)

Geologists at Tulsa Honor Pratt and Wallace

William Edwin Wallace, Jr. (center), receives from President Cram the first President's award of the American Assn. of Petroleum Geologists. Left to right: W. E. Pratt, President Cram, Wallace, E. DeGolyer, and Vincent Charles Illing of the Imperial College of Science and Technology, London

NPN News Bureau

TULSA—The first Sidney Powers Memorial Medal award of the American Assn. of Petroleum Geologists was presented to Wallace Everette Pratt, director and former vice-president of Standard Oil Co. of New Jersey, at the informal dinner sponsored by the Tulsa Geological Society following the association's 28th annual meeting held here March 27.

The award, given "in recognition of distinguished and outstanding contributions to achievements in petroleum geology," is a gold medal displaying a portrait of the late Mr. Powers, internationally known petroleum geologist, and a diploma appropriately inscribed. It was presented by E. DeGolyer.

William Edwin Wallace, Jr., of Standard Oil of Ohio at Shreveport, was the recipient of the first President's Award, $100 and a certificate stating that his article, "Structure of South Louisiana's Deep-Seated Domes", in the association's bulletin, is a significant contribution to geology. A. Rodger Denison of Amerada Petroleum Corp., presented the award which was designed to honor and reward the younger authors of original articles published in the association bulletin.

Retiring President Ira H. Cram (right) presents the first Sidney Powers Memorial Medal to Wallace Everette Pratt, former vice-president of Standard Oil Co. of New Jersey, at the informal dinner sponsored by the Tulsa Geological Society in the streamlined convention of the American Assn. of Petroleum Geologists in Tulsa, March 27

Officers Elected

A certificate of honorary life membership was presented to Mr. DeGolyer by Ira H. Cram, retiring president. At the dinner meeting, Vincent Charles Illing, professor at the Imperial College of Science and Technology, London, spoke on the "Role of Stratigraphy in Oil Discovery".

Officers elected for the coming year include M. G. Cheney, Anzac Oil Corp., Coleman, Tex., president; M. Gordon Gulley, Gulf Oil Corp., Pittsburgh, vice-president; E. A. Koester, Darby & Bothwell, Inc., Wichita, Kans., secretary-treasurer; Dr. Gayle Scott, Texas Christian university, Fort Worth, Texas, editor; J. P. D. Hull, Tulsa, business manager.

The morning session of the streamlined convention heard President Cram speak on "Resources and Resourcefulness".

"Since the organization of the association 28 years ago," he said, "almost 26 billion barrels of crude oil have been won from the earth, and a little over 49 trillion cubic feet of natural gas have been produced and marketed in the United States. In addition, the estimated proved reserve of crude oil has been

enlarged by approximately 14 billion barrels, and the estimated proved reserve of natural gas has been increased between 90 and 100 trillion cubic feet.

"Approximately 26,000 square miles of the United States is covered by oil and gas fields, and about one-third of this area is productive of oil.

"From these fields approximately 29¾ billion bbl. of crude oil and almost 61 trillion cubic feet of gas have been produced, and the proved reserve is estimated at 20 billion barrels of oil and 114 trillion cubic feet of gas. The reserve of crude oil not recoverable at present prices and with present production methods may well be 25 or more billion barrels. We have discovered not only the commonly estimated 50 billion barrels of oil; we may well have discovered over 50% more.

"This presently unrecoverable reserve is a resource of great importance, insufficiently stressed by many observers. How to recover an ever-increasing percentage of the oil we discover presents a challenge to the industry's resourcefulness in general, and to the resourcefulness of geologists and engineers in particular.

"The undiscovered reserve of oil and gas lies beneath certain oil and gas fields that have not been thoroughly tested to basement and beneath an area of approximately 1,600,000 square miles outside the producing fields. Scarcely a sizable part of this prospective territory has escaped attention; yet enormous areas have hardly been scratched by the drill."

Mr. Cram asserted: "Until dry holes have been drilled through the sedimentary column or to the limits of drilling equipment on a high percentage of the geologic anomalies that could be traps and on producing traps, there will be no nearly conclusive evidence that the end of discovery is in sight. However large the undiscovered reserve may be, it is of no practical importance unless it is turned into the proved reserve."

He emphasized that there is a definite need of "selling" more wildcats in the wide-open spaces where geologic evidence may be thin but where the much-needed new provinces may be found.

Hoosier Banker Rips Into Untaxed Co-ops; Says They Fail to Do Part in War Effort

Special to NPN

MT. VERNON, Ind.—The conflict between farmer co-operatives and private business operated by individuals and corporations has been sharpened for residents of Indiana through wide circulation this week of a public reply by Joseph E. Kelley, secretary of the Mount Vernon Peoples Bank & Trust Co., to recent statements of Marvin J. Briggs, assistant general manager of the Indiana Farm Bureau Co-Operative Assn.

Mr. Kelley, banker for 37 years in Posey County and Mount Vernon, watched the growth of Farm Bureau enterprises, including a $1,000,000 oil refinery, in his home city which produces and markets kerosine, gasoline and tractor oil. With profits gained by exemption from federal income and excess profits taxes, the Indiana Farm Bureau and other like co-ops, Mr. Kelley says, are buying in valuable businesses and removing them from the list of federal taxpayers.

The local Posey County Farm Bureau, controlled by the Indiana Assn. of Co-ops, has approximately 700 members and is capitalized at $220,000. Last year's gross business in store goods, oils and greases, baby chicks and other items reached $430,000.

Similar Farm Bureau co-ops exist in almost all of Indiana's 92 counties, many of them exceeding in gross business the Posey County co-operative. Adjacent Kentucky and Illinois are somewhat similarly provided for. Each week sees the Farm Bureau organizations of the three-state area, Kentucky, Illinois and Indiana, announce some new enterprise. At a recent Posey County meeting at which the Mount Vernon banker asserts he was attacked as "ignorant and behind the times" by the Indiana Farm Bureau's leading membership promoter, a new grain terminal was announced for Mount Vernon.

Ad Points to Exemptions

Last week full-page advertisements in Evansville, Ind., newspapers which announced, "Paid for by Joseph E. Kelley," informed readers in a score of counties where co-ops have growing organizations that these county and state groups are not paying their proportionate share of the cost of the war because they are exempt from payment of all federal income tax and excess profits tax.

"This is occurring," said Mr. Kelley, "while the head of the Indiana Farm Bureau Co-Operative Ass'n., Mr. Hassil E. Schenck of Lebanon, Ind., its president, speaks of the present war burden as 'the most staggering debt in all history.'"

Mr. Kelley asserts that co-ops have an unfair advantage in taxation and financing and says the trend alarms him. "They are a definite, pernicious trend toward socialism," his public statement charges, adding: "Many corporations are re-organizing as co-ops with the intent of evading federal taxes."

It was this phase of an earlier Kelley speech which caused Mr. Briggs, who is a director of the Federal Land Bank of Louisville, Ky., when addressing the annual Posey County Farm Bureau shareholders meeting, at New Harmony, Ind., March 8, to call Mr. Kelley "a financier who is either misinformed or who wilfully misrepresents the facts."

He said: "Certain groups object to co-ops and scream of socialism because they can no longer take a toll of seven cents a gallon on petroleum fuels, or rig the price of fertilizers, or charge the farmer 10 cents a bushel for handling his grain." He asserted that co-ops light the way to the future for the farmer.

In his published reply, Mr. Kelley states that he had the Briggs speech recorded and that it contained "threats of reprisal, because I had the audacity to challenge the wisdom and the justice of the law that exempts co-ops from federal taxation.

"I think this law is un-American and should be repealed," his advertisements announce.

He says the law "is fostering an octopus with tentacles reaching into every line of business, and in the last analysis, transforming us into a state where individual initiative and individual reward are out."

Mr. Kelley's "Plain Statement of Facts" lists 25 former corporate concerns which produce oil, lumber, sugar, power, light, dairy products, farm implements, processed foods and provide service of various kinds operating in 12 states from Oregon to Maryland, which have, he says, "re-organized into co-operatives and thus are evading the payment of federal taxes."

Among these 25 corporations are several Kansas and Oklahoma oil refineries, including the Petroleum Products Co., Chanute, Kans.; Globe Refining Co., McPherson, Kans.; Cushing Refining & Gasoline Co., Cushing, Okla.; National Refining Co., Coffeyville, Kans.; Terminal Oil Mill Co., Oklahoma City, Okla.; and other former corporations producing feeds, machinery, and various farm needs.

Like the Red River Lumber Co. of California, which by re-organizing as a Co-op has deprived the government of $900,000 in annual taxes, according to Mr. Kelley, all of the above concerns were once operated as privately owned corporations, and paid taxes.

The Indiana banker asserts: "Mr. Briggs told our Posey County people where I have lived and worked for 37 years that a committee should be appointed to wait on me, and that he would like to be on that committee.

"A committee to wait on me!" exclaims the banker. "In America! In 1945! A committee to wait on me to close my lips concerning an un-American law that legalizes evasion of federal taxes and violates every principle of citizenship and the Constitution."

The 72-year-old Hoosier replied: "My lips will be closed only when Old Charon rows me across the River Styx on my last journey to meet St. Peter."

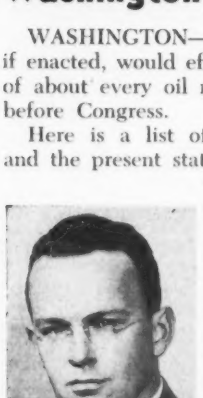
He said the question of co-ops was brought to a climax for him "by thinking of the millions of boys risking and giving their lives, wading the swamps of the Pacific and sleeping in the fox holes of Europe, who when they return will have to foot the bill now being evaded in taxes by co-ops."

PIPELINES—*Views of the Industry's Problems affect*

Washington— *Lowdown on Legislation Before Congress Affecting Oil* —By Herbert Yocom

WASHINGTON—Legislation which, if enacted, would effect the pocket book of about every oil man is now pending before Congress.

Here is a list of the principal bills and the present status of each, together with an attempted prognostication, in the case of some, as to their prospects for eventual enactment into law:



Mr. Yocom

H.R. 2652 — extending the life of the Trade Agreements Act for three years from June 12, 1945. Measure would permit a 50% reduction in the January level of import duties, thus making possible lowering of present oil excise tax to 5¼ cents per bbl. Introduced by Rep. Doughton, endorsed by President Roosevelt and referred to House Ways and Means Committee, which expects to start hearings April 16.

Republicans are organizing to fight additional tariff cuts, arguing that they will make this country a "dumping ground" for cheap foreign products, and also to reduce the proposed extension from three to only one or two years. Opposition is determined this time, but so is the Administration. It's extremely doubtful that bill can go through as written, the only apparent certainty at this stage being that the law will be extended in one form or another.

S.J. Res. 30—to extend the price control law. Introduced by Sen. Wagner and referred to Senate Banking and Currency Committee, which has completed hearings and approved a one-year extension to June 30, 1946. Committee also has at least tentatively rejected all proposed amendments, including one which would have required OPA to treat percentage depletion as an actual cost for the petroleum and all other extractive industries.

Senate probably will pass and send the bill to the House within the next week or so. Hearings are planned by the House Banking Committee, and the percentage depletion issue is expected to be raised again at that time.

H.R. 2760, H.R. 2796 and H.R. 2825—virtually identical bills, introduced by Reps. Stigler, Carlson and Reed, for purpose of writing into the basic tax law the Internal Bureau Regulation which allows producers option of charging intangible drilling costs either to expense or capital account.

Regulation has been held invalid by the Fifth Circuit Court of Appeals to the great concern of PAW and the oil industry generally. While the IRB has said it would not follow the court ruling, all sides desire clarification of the issues involved with the result that prospect for Congressional approval of one or another legislative proposal is good. Bills have been referred to House Ways and Means Committee and industry will be given opportunity to testify.

S.J. Res. 48 and House Joint Resolutions 118, 119, 122, 123, 124, 125, 128, 129, 130 and 134—would declare title to tidal and submerged lands to be vested in the several states, thus ending attempts by the Interior Department and others to claim title for the federal government.

Right now, Secretary Ickes seems to be soft-pedaling on this issue, but Capitol Hill has been stirred up to such an extent that sponsors of the various resolutions undoubtedly could obtain favorable Congressional action if they press for a showdown.

S. 502—authorizes RFC to pay oil subsidies totaling $290,000,000 during the fiscal year starting July 1, thus continuing to the present stripper well, excess transportation costs and other subsidy programs.

Bill has passed the Senate and is now before the House Banking Committee, which is expected to report the measure to the House for early action.

S. 680—to amend General Leasing Act to require Secretary of the Interior to grant preferences in the sale of royalty oil from the public domain to refiners who lack their own sources of crude supply.

Introduced by Sen. O'Mahoney, the bill was referred to the Interior Depart. on March 7. Department has not yet replied. Senate Public Lands Committee probably won't hold hearings unless Secretary Ickes opposes enactment of the measure.

H.R. 2600—extends life of Cole Pipe Line Act to June 30, 1947, or two years from present expiration date.

Act authorizes federal government to acquire rights-of-way for interstate pipe

(*Continued on p.* 15)

Atlantic Coast— *Hilts and ESPA Clash with PAW Over Supplies* —By Frank P. S. Glassey

NEW YORK—The Empire State Petroleum Association, through Harry B. Hilts, its secretary, is currently engaged in a controversy with Charles L. Harding, director-in-charge of PAW Dist. 1, over what Mr. Hilts charges is the failure of PAW to insure equitable distribution of petroleum products in this area.

Mr. Glassey

Thus far the verbal brickbats have been flying back and forth by correspondence, with the latest development a coldly polite letter from Mr. Harding asserting that the Hilts objections to distribution plans are "vague" and inviting specific evidence of any inequities as regards secondary suppliers.

The first ESPA letter, dated Feb. 16, urged more "equitable distribution of available product" and said that ESPA is considering "another course of policy unless remedy and relief are in prospect." Mr. Hilts suggested the following "remedial measures":

"1. Let all allocations be made wholly on a supply terminal basis instead of on a zone basis.

"2. Let a fair and equitable position be set up for each secondary supplier who in a specific supply terminal area purchases from an original supplier.

"3. Let a competent check system be instituted on the distribution of original supplies down to the secondary level to assure that original suppliers live up to the trusteeship accorded them under Directive 59."

To this Mr. Harding replied that he was "disturbed" by the "threat" that ESPA is considering a course of opposition rather than cooperation with PAW. He declared that "such conduct will result only in harm to all persons affected and cannot possibly achieve beneficial results." He denied that PAW has discriminated against secondary suppliers, and said the agency has made every effort to insure equitable distribution.

To the specific suggestions made by Mr. Hilts, Mr. Harding said:

"The first two proposals made at the end of your letter have been advanced by you on previous occasions. They have been thoroughly explored and studied. There are many who disagree strongly with the proposals. After a careful consideration of all the factors, they were rejected in favor of the present program.

"With respect to your third proposal, steps have been taken in a general way to this end. If, however, you wish to present a workable 'check system' of the type suggested, we shall be very happy to review it to determine its feasibility under our present operations."

Mr. Hilts responded to this statement with a rather acrimonious four-page letter, in which he told Mr. Harding that

"we do not believe you or your predecessors in the district director's office have taken proper advantage of, or made full use of organizations such as ours in the 'wartime task of achieving an equitable distribution of available product.' We readily admit that PAW has accomplished the goal of fair and equitable distribution at the original supplier level; but from there on down it is a different story."

"No competent thoroughgoing attempt," Mr. Hilts continued, "has ever been made by PAW Dist. 1 to set up satisfactory procedure so that secondaries may receive their fair share of available products. And the fact remains that most secondary suppliers are able to continue in business today merely because of the suffrance of the original suppliers who are interested in preserving customer relationships under the ambiguous language applicable to secondaries under PAO 1."

The final note in the controversy (up to the moment of writing) was uttered by Mr. Harding, who last week sent Mr. Hilts a formal acknowledgment of his latest communication, and then added:

"As I pointed out in my previous letter, the conditions to which you voice vague objections are under the direction of Mr. John Harper, who, in my opinion, is the last person who would discriminate against any class of suppliers in the distribution of petroleum products.

"Likewise, it was pointed out that anyone who feels that he has not been fairly dealt with should present specific evidence to this office so that proper action may be taken.

"Mr. Harper's division is always available for this purpose and invites anyone who feels that he is not being accorded fair treatment to present his case to PAW for such action as might be appropriate."

* * *

Ambitious plans are being mapped for postwar Venezuelan oil production and refining, even though the scope of Venezuelan markets after the war is still an indeterminate quantity.

A. T. Proudfit, president of Creole Petroleum Corp., Venezuelan subsidiary of Standard Oil Co. (N. J.), revealed here last week that the company will build a refinery, at a site so far unselected, which will more than double its present capacity of 47,000 b/d. The refinery, which will be constructed "as soon as materials are available," will cost about $50,000,000, and will turn out lubricants, aviation gasoline and premium motor gasoline.

Mr. Proudfit is optimistic about postwar marketing prospects, so far as his company is concerned. Venezuela's normal markets, he said, are "eastern and western South America, the east coast of the United States and northern Europe." He admitted that Venezuelan crude will be competing with oil from the Near East after the war, but said that "Near East oil will be highly competitive everywhere in the world." Creole, he believes, will probably ship more heavy fuel oil to the United States after the war than before Pearl Harbor.

Midwest— *Davies' Mis-quoted Statement in Los Angeles Caused a Flurry* —By Earl Lamm

CHICAGO—Midwest oil men were afflicted with butterfly hearts Saturday when news reports from Los Angeles misquoted Deputy PAW Davies, as saying V-E Day would bring an increase of possibly 50% in civilian gasoline rations. The story was like the premature armistice reports for 9/10th of a gallon increase on "A" cards won't even permit housewives much additional leeway in pursuit of the elusive dinner steak.

Mr. Lamm

Several things gave the report a true ring—the military in Europe had just declared it had sufficient gasoline on hand to carry the army to Berlin and would not be held up this time; Gen. Eisenhower and Sec. Stimson had both stated that Germany was beaten in the West; PAW Ickes had announced that tankers had been removed from East Coast Service, and the Bureau of Mines figures released on Friday showed gasoline stocks in this country had reached a grand total of 99,012,000 bbls., which is close to an all time peak and one which is causing some refiners to look for a weakening of the market. War Mobilizer James F. Byrnes had also just made his final report to the President and announced a program for limited conversion.

And regardless of the story from Los Angeles, there are many oil men in the Midwest, with a finger on industry pulse, who say quite earnestly that we are not going to be able to drink all of the gasoline there will be a short time after V-E Day, but that if American motorists want their driving freedom back they will have to fight the bureaucrats to recover it. The thousands of telephone calls received at newspaper offices and other news centers last week before the false armistice report was cleared up, seems to indicate that maybe the public is willing to do a little battling when the proper moment arrives. There are many citizens who would like to do an honest day's work and quit spending so much time with red tape and running to and from ration boards.

* * *

One report the oil and gas industry can hope is not true concerns the transfer of control of the Federal Power Commission, Federal Trade Commission, Securities and Exchange Commission and Interstate Commerce Commission to the Department of Commerce under Henry A. Wallace to compensate him for loss of the federal loan agencies that were removed when Jesse Jones departed. FPC has been impatiently biting its finger nails to start setting up further controls over natural gas, and Mr. Wallace could be expected to further those ends. Also, a couple of years ago SEC was giving oil royalty owners some pretty stiff requirements to meet. The Wallace touch to those various agencies likely would bring many things to life.

While we are on the subject of quotes and misquotes, it seems OPA got its wires crossed last month when the regional office at Chicago released a press statement quoting Mr. Bowles as saying the half dozen suits against refiners in this area involved "millions of dollars" in overcharges and put a price squeeze on Independent jobbers and retailers.

When some of the refiners' attorneys first read Mr. Bowles' statement about "millions of dollars" being involved, they pooh-poohed the thought.

Mr. Bowles now says he was misquoted and that such statements are premature until a check up of the "open end" suits is completed.

Thus it appears that OPA caught its own tail in the ringer as B. L. Majewski, chairman of the Dist. 2 D & M committee points out that OPA's price department has been fairly careful in adjusting subnormal tank wagon ceilings and maintaining generally minimum jobber margins. And we might add that this was accomplished only after said jobbers had done much protesting and made many trips to Washington.

However, some jobbers doubtless do feel the squeeze where prices were upped in the manner outlined in this column March 14th, but we fail to see where retailers are involved unless jobbers in those instances sought relief on the topside of their ceilings.

Gulf Posts Crane County Crude

NPN News Bureau

TULSA — Gulf Refining Co. announces schedule for Ordovician crude purchased from Sand Hills-Ellenberger-West field, Crane County, Texas, beginning Below 25 gravity at $0.93 with 2c differential for each degree of gravity to $1.25 for 40 & Above, effective Mar. 7.

Industry Uncertain as IRB Promises Old Tax Rule On Drilling Costs; Congress Action Sought

NPN News Bureau

WASHINGTON — Efforts to enact the Internal Revenue Bureau's court-disputed intangible drilling costs regulation into law were intensified in industry and on Capitol Hill this week despite IRB Commissioner Nunan's assurance that the 27-year-old ruling would remain in force.

Mr. Nunan wrote former Rep. Wesley Disney of Oklahoma that IRB would continue to follow the provisions of Section 23 (M)-16 of regulations, "and corresponding provisions of prior regulations. notwithstanding decision in case of F. H. E. Oil Co."

"In the event," he added, "of clarification of the law impelling such a change, in no event would such a change be retroactive unless so directed by Congress."

Realizing that the issue is by no means closed, however, because other adverse decisions might threaten the regulation in the future, Congressmen who have introduced bills which would validate the present regulation said they intend to press for early consideration of those measures.

Rep. Reed (R., N. Y.) has written to Chairman Doughton (D., N. C.) of the House Ways and Means committee to ask that hearings be held on his drilling-costs bill (H. R. 2825), introduced in slightly different form from his earlier bill, H. R. 2720. Passage of his bill, Rep. Reed said, would "take care of the matter once and for all."

Another interested Congressman, Rep. Carlson (R., Kans.) said he believed it still advisable for Congress to pass clarifying legislation. He added that there were "enough votes to do it."

Attorneys Continue Work

At the same time, industry attorneys were continuing their conferences as a prelude to filing their briefs as "friends of the court" in support of a rehearing petition in the F. H. E. Oil case. Nor was there any change in plans of the industry's general depletion committee to meet in St. Louis April 4 to review the situation and discuss proposed "clarifying" action by Congress to end the drilling-costs dispute.

By "clarification," IRB officials said, Mr. Nunan meant either Congressional action or a U. S. Supreme Court decision. If the F. H. E. case were appealed to the Supreme Court, for example, and the decision of the lower court sustained, IRB would have no alternative but to drop its drilling costs regulation.

Despite this ultimate possibility, however, industry leaders believe the present situation is considerably brighter than when the F. H. E. decision was rendered early last month. Among these is Russell B. Brown, I. P. A. A. general counsel, who said after conferring with IRB officials that Commissioner Nunan's action to keep the regulation in force "removes a great load from the industry."

"The decision is encouraging," he continued, "because it re-establishes confidence in the integrity of bureau regulations. It will remove much of the fear engendered by the court decision in the F. H. E. Oil (case) and should enable the industry to have a greater feeling of confidence in the stability of relationships between industry and government."

Not the Last Answer

Mr. Brown warned, nevertheless, that IRB's decision to keep its regulation in force "is not the last answer to our problem.

"I do not understand that we can now sit down and depend upon the continuance of this regulation without some effort to insure its character in permanent form," he said. "This effort, in fact, must be of large scope and no time should be lost in exerting it. At the meeting in St. Louis this week, the general depletion committee, with nation-wide representation, will undertake to recommend the type of effort that will be required."

Although every effort should be made to obtain correction of the F. H. E. Oil decision in the Fifth Circuit Court of Appeals, the I. P. A. A. general counsel said this alone would not prevent similar attacks from other sources.

"In my judgment," he asserted, "the real remedy is for Congress to make clear its intention to preserve in substance the regulation originally made to meet a condition that required specific treatment. The history of the industry, operating for more than 25 years under the tax principle embodied in the regulation which was held invalid, justifies Congressional support of the effort to have this question cleared up for all time."

Earlier this week, when Rep. Carlson offered his bill (H. R. 2796) to enact the intangible drilling costs regulation into law, he warned that smaller operators "cannot continue under the tax policy which has been laid down in the decision of the court."

"Uncertainty, confusion and discouragement now exist in the oil-producing industry as the result of this decision," he added. "Operators will not drill more wells when they feel that bankruptcy will be the penalty.

"It will be easier merely to operate the wells they have and undertake no replacements for their constantly declining production from such wells. The national effect will be great and it will be tragic."

After Rep. Carlson introduced his bill, Rep. Reed told the House:

"It has been said by some of the men who are very familiar with the oil business that if the Japanese were able to get into this country and blast our refineries they could not possibly injure this country, the oil interest, and the war cause any more than the Circuit Court decision has done."

He added that he hoped an early hearing could be had on proposed legislation, so that the IRB regulation "can become the law of the land and relieve the oil people and business men of the confusion which now exists."

Another speaker condemning the F. H. E. Oil decision was Rep. Domengeaux (D., La.) who told the House: "Such a decision, if permitted to stand, will paralyze oil production throughout the country. Its effect on the war effort especially, and on domestic petroleum needs, can be quickly realized.

"The court action," he continued, "is a drastic blow to the smaller operators whose courage, initiative and industry in developing new sources of oil were responsible in a large measure for the fact that the United States had such large and vital oil reserves ready for use when the war began."

Service Station Manual For Veterans Revised

NPN News Bureau

WASHINGTON—The service station manual being prepared by Commerce Department for purpose of telling returning soldiers how to get into and operate the business is undergoing extensive revision, this time at the request of War Department.

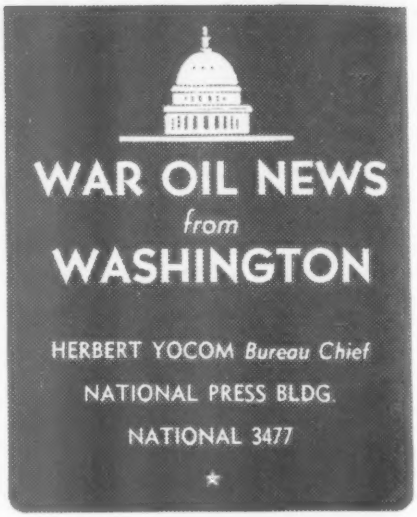
Modifying previous specifications, the Army objected to inclusion of too much technical detail in the document and it is now being trimmed to place more emphasis on the operational and management side. The number of illustrations also is being reduced.

The date the manual will be finally completed is still uncertain, due principally to printing job involved.

Seek Tidelands Bill Report

NPN News Bureau

WASHINGTON—The Senate Judiciary Committee will request reports from Interior, Justice and State Departments on S. J. Res. 48 by Sen. McCarran of Nevada, which would vest title to U. S. coastal tidelands in the states.



High Court Affirms FPC Right to Fix Gas Rates On Basis Including Production and Gathering

NPN News Bureau

WASHINGTON—The Supreme Court this week handed down three decisions upholding the right of Federal Power Commission to include production and gathering costs in the fixing of natural gas rates. In doing so, court re-iterated its stand, taken in the earlier case of FPC vs. Hope Natural Gas Co., that "the commission is not bound to use any single formula for fixing of rates."

In two cases—Panhandle Eastern Pipeline Co., Illinois Natural Gas Co. and Michigan Gas Transmission Corp. vs. FPC, City of Detroit, County Wayne, Michigan, et al, which was decided unanimously, and consolidated case of Colorado Interstate Gas Co. and Canadian River Gas Co. vs. FPC, city and county of Denver, Public Service Commission of Wyoming, et al—the court held that a "fair and equitable rate" had been set by FPC despite petitioner's objections that commission had no actual authority over production and gathering costs.

In another case, decided by 5 to 4 margin, Colorado-Wyoming Gas Co. vs. FPC, Colorado Interstate Gas Co., city and county of Denver, et al, a companion case to the Canadian River, the court sustained the lower court's judgment "insofar as it sustained the order of the Commission directing petitioner to reduce its rates by $98,000."

No rate reduction beyond that figure was allowed, however, and the court remanded the issue to FPC "for separate allocation of investment and operating costs between the regulable and non-regulable properties, as well as for the clarification of findings directed in the opinion."

Deny 'Fair Field Price'

In the Canadian River-Colorado Interstate case, court's majority opinion, delivered by Justice Douglas, held against petitioner's arguments that FPC should allow in the operating expenses of a natural gas company whose rates it is empowered to fix, the "fair field price" or "fair market value, as a commodity," of the gas which finds its way into the transmission lines for interstate transportation and sale.

"This is precisely the argument which West Virginia, appearing as friend of the court, advanced in the Hope Natural Gas Co. case," wrote Justice Douglas. "We rejected the argument in that case. We have reviewed it here at this length in view of the seriousness with which it has been urged not only by Canadian but also by the Independent Natural Gas Assn., which appeared as friend of the court. But we adhere to our decision in Hope Natural Gas Co. case and will briefly state our reasons . . .

"When a natural gas company which owns producing properties or gathering systems is restricted in its earnings by a rate order, value of all of its property is affected. Congress, of course, might have provided that producing or gathering facilities be excluded from the rate base and that an allowance be made in operating expenses for the fair field price of the gas as a commodity. But we search the act in vain for any such mandate . . ."

Court held, however, that its decision does not strip all meaning from that part of Sect. 1(B) of the Natural Gas Act which provides that the act shall not apply "to the production or gathering of natural gas."

"Certainly," said the majority opinion, "that provision precludes the commission from any control over activity of producing or gathering natural gas. For example, it makes plain that the commission has no control over the drilling and spacing of wells and the like. It may put other limitations on the commission. We only decide that it does not preclude the commission from reflecting the production and gathering facilities of a natural gas company in the rate base and determining the expenses incident thereto for the purposes of determining the reasonableness of rates subject to its jurisdiction."

The court asserted that in the Hope case and in case of FPC vs. Natural Gas Pipeline Co., it held: "The question for the courts when a rate order is challenged is whether the order, viewed in its entirety and measured by its end results, meets the requirements of the act. That is not a standard as vague and devoid of meaning as to render judicial

Tributes Paid Trio Leaving PAW Posts

PAW says farewell to three leaving Refining Division: Guests of honor at a buffet supper were (standing, left to right), E. W. Evans, William R. Argyle, and Reuben Werlin. Presiding at the shindig was Refining Director A. P. Frame, (left, seated), while the oratorical flourishes were provided by Distribution and Marketing Director Walter Hochuli. Mr. Argyle has returned to Sinclair Refining Co. after 21 months service as assistant and associate director of Refining. Mr. Evans has returned to Phillips Petroleum at Bartlesville, having completed a special assignment in connection with butane supply and utilization, while Mr. Werlin, chief of the Facilities Section, will resume his private law practice at Houston.

NPN News Bureau

WASHINGTON—Back to Sinclair Refining this week, after 21 months with PAW, went William R. Argyle. The PAW Associate Director of Refining resigned, effective April 1, and is resuming his position with Sinclair as assistant manager of refining, a post he left in September 1943 to join the war oil agency.

"We drafted Mr. Argyle to the Petroleum Administration," said Deputy PAW Davies in announcing his resignation, "because of his extensive experience in all branches of refining. We knew that this experience would help immeasurably in achieving the present record-breaking production of petroleum products. He has managed, by his ability, patience, and hard work, to promote a closer cooperation among refiners, and between refiners and the Petroleum Administration."

review a perfunctory process. It is a standard of finance resting on stubborn facts."

"We cannot say, as a matter of law," the court concluded in Canadian River decision, "that the commission erred in including the production properties in the rate base at actual legitimate cost. That cost could be determined only on consideration of the end results of the rate order, a question not here under the limited review granted the case."

Dissenting in the Canadian River case were Chief Justice Stone and Justices Roberts, Reed and Frankfurter. They said they were of the opinion that FPC, "in making the rate order here under attack, exceeded its jurisdiction and reached a result which must be rejected because unauthorized by the applicable statute."

WPB Opens Drive to Boost Carbon Black Output 100,000 Tons, Relieve Rubber Industry

NPN News Bureau

WASHINGTON—WPB this week unveiled a new big carbon black program designed to add about 200,000,000 pounds a year to meet needs of U. S. rubber manufacturing industry, essential exports and to build up a 30-day inventory, considered a minimum safe working supply.

Besides priority assistance—AA-1 to all projects for expansion of facilities in the carbon black industry—thirteen other steps have been agreed upon by an Inter-Agency Carbon Black Committee, which was set up March 10 by War Mobilizer Byrnes to break the bottleneck which is currently restricting manufacture of vital rubber products.

Three of these steps will be taken by PAW, which will:

1. Make available 10,000 bbls. of naphtha and 2,000 bbls. of gasoline residue a day. This will add about 1,500,000 lbs. per month of carbon black. It will require from six weeks to two months to install equipment to process these additional raw materials.

2. Make available 115,000 gals. of propane gas per day immediately. This will make possible an increase in carbon black production of 1,000,000 tons per month.

3. Make available, as soon as heating demands recede—probably within a month, an additional 150,000 gals. of propane gas daily.

Ten Other Steps

The other 10 steps agreed upon by the committee are:

The Texas Railroad Commission "is assisting in the emergency by obtaining additional sources of gas for several carbon black plants in Texas. WPB estimated that this action will permit the manufacture of 1,500,000 additional lbs. of carbon black at once. It is understood that the Commission stipulated, however, that carbon black manufacturers pay at least 5 cents per million B.T.U.'s, which will in many cases raise the price of the gas to a figure higher than that, since much of the gas involved is rich and will supply more than 1,000,000 B.T.U.'s per thousand cubic feet.

The War Department has been requested to take steps to obtain production of carbon black from existing facilities in France.

The possibilities of producing carbon black in the Middle East are being investigated.

In Louisiana other steps are being taken to permit the use of sweet gas.

The War Manpower Commission has instructed regional and area offices to give the carbon black industry the top labor priority.

The Inter-Agency Carbon Black Committee is also reviewing the export requirements for carbon black. Temporarily, at least, WPB said, it is expected that as much as 5,000,000 lbs. of carbon black per month may be diverted from export to the rubber manufacturing industry in the U. S.

The production of carbon black in California, the Mid-Continent areas and in Canada, where sweet gas may be used, is being pushed.

The carbon black industry and government agencies, particularly PAW, are taking steps to make enriched gas available to the industry wherever possible. It is estimated that this will increase production from existing facilities by as much as 40% in some plants.

With the announced AA-1 preference ratings, it will be possible for both Defense Plant Corp. and Defense Supplies Corp. to expedite new facilities, of which about 20 are scheduled for completion in the next six months.

Price Ceiling Raised

In addition, OPA has issued an order which allows producers of rubber grades of channel carbon black higher price ceilings. These price increases are above the minimum required by law. DSC will buy all of the carbon black output and resell it to the rubber industry at a flat price, based upon the estimated weighted average acquisition cost.

The price increases, OPA said, "will vary, depending upon the raw materials used." Prices will be determined by each producer, using a formula set forth in the new pricing provisions (Amendment 3 to Supp. Reg. 14F to the General Maximum Price Regulation, effective March 31, 1945). In brief, the formula (for all except new plants) permits the addition of current raw material cost per pound to specified conversion costs in effect during the first six months of 1944.

Higher costs in operating certain new and rehabilitated plants were previously provided for by OPA when a formula was supplied producers by which higher ceiling could be determined for "easy processing" channel carbon black when specified high-cost production conditions existed.

Now, OPA has expanded this formula so as to include all rubber grades of channel carbon black and to include a wider range of high-cost conditions. It also includes an automatic adjustment provision to take care of increased costs arising out of raw material contract revisions for existing production.

Meantime, OPA is attempting to solve the question of natural gas prices, as they pertain to the new carbon black program. Telegrams were sent this week to Warren Petroleum Corp., Hanlon-Buchanan Inc., Carter Oil Co., Skelly Oil Co., Sinclair Refining Co., Cities Service Oil Co. and Lone Star Gas Co., pointing out that no maximum prices have been set for liquefied petroleum gas for sale to carbon black manufacturers.

OPA asked the companies to apply under Section 8.3 of MPR88 for price ceilings.

Tanham Quits WLB

James Tanham

NPN News Bureau

WASHINGTON—Resignation of James Tanham, a vice president of The Texas Co., as an industry member of the War Labor Board was announced this week to be effective April 30.

In a letter to the President, Mr. Tanham gave "necessity of devoting more time to private business affairs" as his reason for retiring from the board on that date. He has served with WLB for three years—first as an industry panel member, then as an alternate member of the board, and finally as a full-fledged member.

Butylenes to be Turned Back

WASHINGTON — Because of increased rubber requirements, government agencies have determined that butylenes diverted to the 100-octane program last January will have to be switched back to the butadiene-for-synthetic-rubber program by mid-year NPN learned this week.

WASHINGTON

(*Continued from p.* 10)

lines, such as was done in the case of the Big and Little Big Inch lines. House Interstate Commerce Committee plans action "as soon as possible" and bill will be enacted if War Agencies say it is necessary.

S. 368—would block postwar use of Big and Little Big Inch pipelines for transmission of natural gas.

Introduced by Sen. O'Daniel and still reposing, as of this date, in a Senate Interstate Commerce Committee pigeonhole. Similar bills introduced by the Texan in past Congresses never were acted upon and this one seems to be in for a like fate.

S. 713—the old Ellender tire bill under new sponsorship, this time Sen. Murray, of Montana.

Bitterly opposed by various oil interests in the past Congress, the bill would grant independent tire dealers exclusive right to retail motor vehicle tires. It is pending before the Senate Banking Committee, which held hearings last year on the Ellender bill and decided to do nothing about it.

H.R. 55—to divorce ownership of pipe lines.

As in the past several Congresses, this one is authored by Rep. Izac, of California. Earlier bills were pigeonholed by the House Interstate Commerce Committee and this one is headed in the same direction.

S. 2 and S. 34, and H.R. 674—authorizing postwar airport expansion programs.

Senate Commerce Committee has completed hearings and House Interstate will get around to taking testimony sometime after May 1.

BYRNES REPORT

(*Continued from p.* 3)

son of Colorado, up to now one of the chief sponsors of the bill, who said:

"With Mr. Byrnes anticipating a letting down of controls as V-E Day comes, why should we be asked to impose new ones on workers? And now, with Mr. Byrnes resigning from his post, presumably to take another outside the war program, why should we 'freeze' other men to their jobs?"

Highlights of Report

Highlights of the Byrnes report, with emphasis on those of particular concern to the petroleum industry follow:

1. Approximate estimates, based on assumptions as to V-E Day, "indicate that the over-all release of resources from munitions production will exceed the reductions in military schedules and in the first quarter following the defeat of Germany will be about 20%; an additional 5% will be released in the second quarter, and still another 5% in the third quarter."

2. Construction of military facilities is now under review, with the result that the war mobilizer "has already disapproved the construction of certain additional high octane gasoline plants which would not come into production until well into 1946."

3. Because of recent cancellation of orders for 46 tankers, plus cutbacks in other shipbuilding programs, the programs of the Navy and Maritime Commission, which are now on curtailed production schedules, "will undergo little further change after V-E Day."

4. WPB proposes to discontinue the controlled materials plan "as quickly as it is no longer needed to protect military and essential civilian production. It should be possible to substitute a simple priorities plan for the controlled materials plan in the quarter following V-E Day with CMP orders on the mills, in effect, continuing for an additional quarter." Some few (war) supporting civilian activities "may have to be given priority rations." The present AAA priority band and the directive system will be retained to break bottlenecks.

5. It will be necessary to continue wartime transportation regulations "such as . . . control of rail movement to the ports to prevent congestion, and high demurrage charges to speed up turnaround of freight cars." The railroad manpower situation should improve in second quarter after V-E Day, but rolling stock "still will barely suffice to meet demands."

6. The V-E Day program of economic stabilization requires extension of the price control act, continuation of wage controls and maintenance of high excess profits taxes and present authority to recapture and control corporation profits by renegotiation.

7. WPB will prevent extensive inventory building, which might impede access to materials by small business.

J. J. Theisen Is Dead at 63; Veteran Michigan Marketer

Special to NPN

ST. JOSEPH, Mich. — J. J. (Jay) Theisen, 63, veteran Michigan oil marketer, died here on March 29.

Mr. Theisen, president of Theisen-Clemens Co. and a director of the Mid-Continent Petroleum Corp., started hauling kerosine around St. Joseph in a 210-gal. horsedrawn tank wagon 44 years ago.

Mr. Theisen

Until a few days before his death Mr. Theisen had been active in the operation of one of the country's largest independent oil companies. He became associated with Mid-Continent Petroleum Corp. in 1914, becoming a director of that company in 1925.

Mr. Theisen's eldest son, Clemens, is manager of the company's Detroit terminal, and Cyril is president of Theisen Tire & Truck Supply Co., Inc., which also handles service stations' accessories.

Funeral services were held in St. Joseph on April 2, at St. Joseph's Church.

Group 3 Pricing Set On Midwest Fuel Oils

NPN News Bureau

WASHINGTON—OPA this week issued a Group 3 method of computing delivered-at-destination prices on fuel oils in eleven midwestern states along with several other changes in MRP88, one affecting jet plane fuel.

Effective April 7, suppliers will compute delivered prices on range oil, No. 1 prime white distillate, No. 1 straw fuel oil, No. 2 fuel oil and No. 3 fuel oil in Illinois (except Chicago), Indiana, Iowa, Kansas, Michigan (except southern peninsula) Minnesota, Missouri, Nebraska, North Dakota, South Dakota and Wisconsin, as follows:

1. If the supplier had a contract with a tankwagon reseller on Oct. 1, 1941, which had been in effect for at least one year, his maximum price must be determined under Section 5.2 of MPR88. In other words, contract prices will not be disturbed by the new amendment.

2. To consumers and other resellers, any supplier's maximum delivered-at-destination price for any of the above products (ex taxes applicable to the sale but not the transportation) shall be Oct. 1, 1941, rail rate from Tulsa to the destination plus the amount designated below for the particular product (figures in cents per gal.):

Range, stove or heater oil—4.00c; No. 1 prime white distillate—3.875c; No. 1 straw fuel oil—3.75c; No. 2 fuel oil—3.625c; No. 3 fuel oil—3.50c.

The following changes were also made by OPA in amendment 26 to MPR88, all of which are effective April 7.

1. Ceiling prices for jet plane fuel will be established on individual application of sellers to OPA's national office in Washington. To avoid any possible uncertainty as to which price regulation covers this new production, OPA has specifically listed it among the products covered by MPR88.

2. Standards are redefined by which "eligible marketer" sellers and "eligible brokers" may qualify, either automatically or by order, for specified mark-ups over ceilings spelled out for refineries.

3. One delivered ceiling price of 3.8c per gal. is set on all tank car sales of No. 5 fuel oil to tank wagon resellers in St. Louis, Mo., and East St. Louis, Ill. One ceiling of 5.4c per gal. is also established on the same product in the same two cities for tank wagon resales.

4. Existing f.o.b. refinery ceiling prices in the Chicago refining area for range, stove or heater oil and Nos. 2 and 3 fuel oil are made applicable to spot sales to any reseller in the same area. Up to now, these prices had applied only on sales to tank wagon resellers.

WITH WARREN PLATT IN ITALY

(*Continued from p. 5*)

days almost 400,000 men had been put ashore with some 65,000 land vehicles.

The invasion of Sicily July 10, 1943, was a little smaller operation in number of men but because of the extremely limited territory to be covered, it was considerably smaller as to vehicles. However, in 14 days, two armies were landed on Sicily totaling nearly 300,000 men with 32,000 vehicles. In addition to the fuel for these land vehicles the Navy required nearly 2,000,000 bbls. of furnace oil and Diesel, and 50,000 bbls. of 100-octane aviation for its part in the attack on Sicily. Then to "soften" the resistance on that island the Air Corps in some 40 days all told, half before "D" day and half after, used 1,000,000 bbls. of 100-octane.

Shipments in 'Flimsies' Prove Costly Experiment

Even as it was, tremendous quantities of filled drums had to be imported, until the bulk petroleum facilities could be constructed. Within the first year 12,000,000 cans and 2,500,000 drums were brought in. At the one port of Oran, the first point of landing after passing Gibraltar on the south coast of the Mediterranean, in addition to what the first ships brought with them there was dumped on the docks and beaches at this one port alone in the first seven days after the landing 200,000 drums of gasoline and 12,000 five-gal. drums. Nineteen days later there was dumped at this same port an additional 100,000 55-gal. drums and 30,000 five-gal. drums.

For the first two months of the campaign there was unloaded at all initial invasion ports a grand total of nearly 700,000 55-gal. drums of gasoline while the tankers unloaded in bulk during that period another 500,000 bbls. And to make all these drums useable there came in at the same time 1000 hand pumps to be checked and distributed along with the drums.

Then to add to the difficulties, thousands of additional packages were shipped in "flimsies", ordinary tin cans of five gals. By the time these ships reached Africa the toss of the ships and weight of the top rows of cans had crushed the bottom "flimsies" so that as much as five feet of gasoline swashed around in the holds and men were knocked out by the fumes in trying to unload. The gasoline loss from the "flimsies" totaled 32% by the time they were discontinued. It was a further reason for bulk handling.

To Dec. 31, 1944, 31,500,000 cans of all kinds have been brought into this theater of which 13,250,000 are of the returnable jerrycan type. In addition 5,000,000 drums of 55 gals. have been imported.

How the Job was Done; Here's the Story of the Organization and How It Came Into Being

The foregoing is a general outline of the big job that was done and how well it was done chiefly by men from the oil industry. But there is also an equally interesting story as to just how this job was accomplished, what kind of an organization did it and how did it come into being. This, too, will be sketched with only the important features of its development.

The oil organization in the Mediterranean, like the oil organization in northern Europe and elsewhere in the theaters of this war, came quite naturally from the growing realization by the old Motor Transportation Corps at Washington, then under the Quartermaster, of the size of the job of fueling the proposed mobile equipment for the prospective army. Fate oftentimes seems to have the right man in the right job at the right time and that seems to have been the case with this Army oil transportation job.

A dozen years ago, a then young graduate of West Point who came out of the academy at the close of the last war, was in the motor transport division and much interested in all the problems of automotive engineering, so much so that he took a year's course on the side, at the University of Michigan, on that subject, as well as in management. In the Army he was assigned to the problems of better trucks to meet army needs, and to truck operation and maintenance. When this war came he helped in the design of much of the equipment the army now uses, including the famous "jeep" which, by the way, was designed solely for cross country, with a machinegun mounted in its middle, and not for ordinary road work which is probably its greatest usefulness today, much to the discomfort of those who have to ride in it.

When this war came, this officer was on duty with the then relatively small Motor Transport Division of the Quartermaster's office. His was the job of seeing that the growing use of transports in Army maneuvers was successful; that there were enough transports to bring up all the supplies the Quartermaster had to furnish the troops and that the trucks were properly maintained.

His problems included containers for gasoline and oil. As he kept re-estimating the number of trucks required and increasing his figures on the necessary gasoline to fuel them, he ran into prodigious quantities of containers. He and others tackled the container problem, drums and cans and then Jerrycans with a sample of that which the Germans were using. But his prospective stacks of containers grew still higher and spread, figuratively speaking, over still more and more acres of storage ground.

That brought this officer to bulk han-

Pet Section Programs Demands at Monthly Meetings

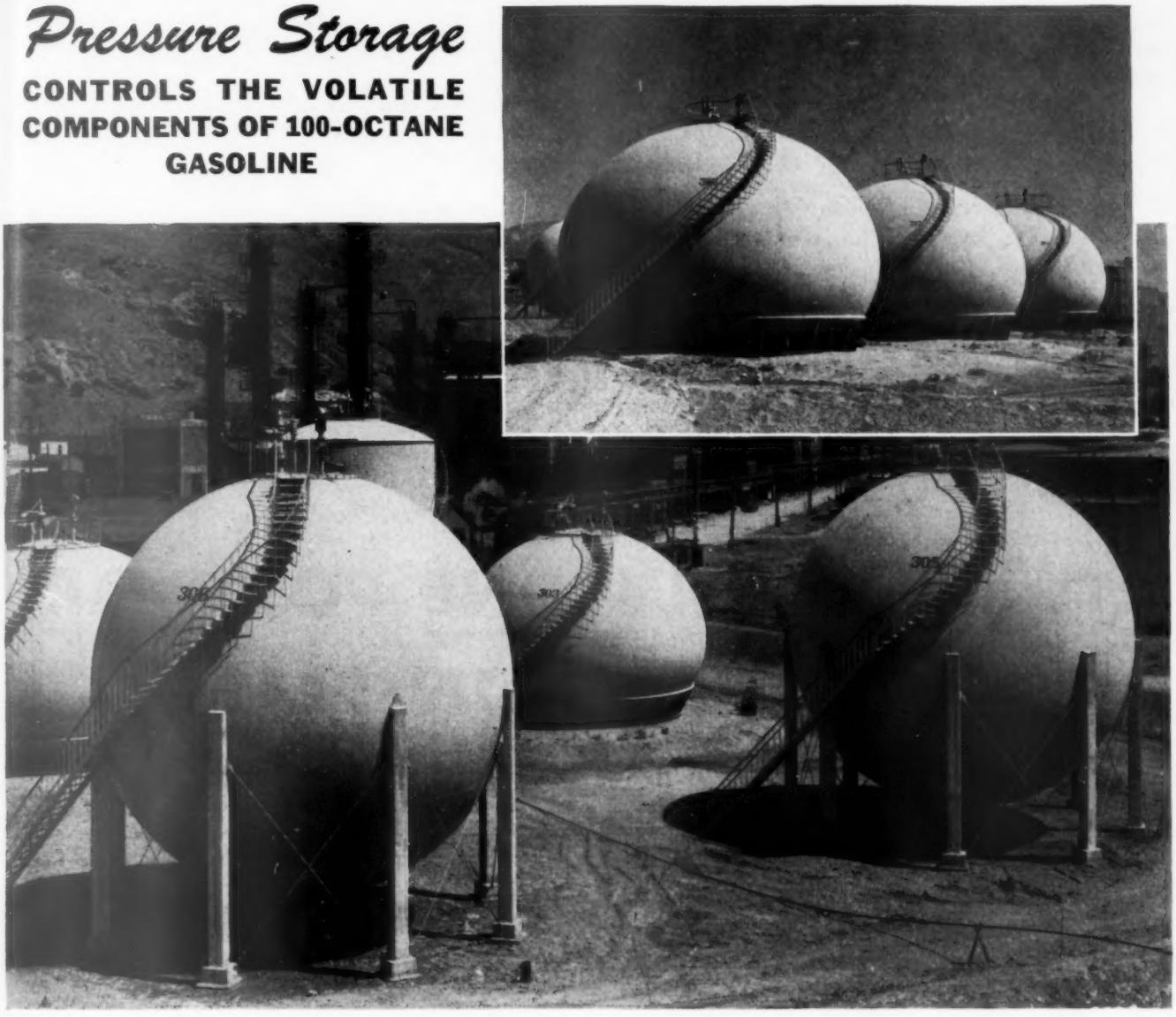
Bidding for products at a "slate meeting"

Tight control of all petroleum supplies in the Mediterranean area is kept through the medium of "slate meetings" which are held monthly at headquarters of PET SEC. Each petroleum consuming unit in Army and Navy of all Allied forces and the countries whose civilians get a little gasoline, submit to this group their ideas as to their needs for four months in advance. Each month a fourth month's figure is added as the current one is dropped.

These bids for products are carefully checked and a schedule made up which is discussed at these meetings. The meetings do not take long, often not more than an hour but bringing these men in from all the branch offices of PET SEC permits its chief, Col. G. H. Vogel, to have a personal chat with each man and make sure that the "slate" is a true picture of the oil situation.—WCP

Pressure Storage

CONTROLS THE VOLATILE COMPONENTS OF 100-OCTANE GASOLINE



AT the Utah Oil Refining Company's 100-octane gasoline plant at Salt Lake City, Hortonspheres and Hortonspheroids provide part of the storage facilities for the volatile components of aviation gasoline. These pressure storage tanks are used primarily because they prevent evaporation losses.

Hortonspheres and Hortonspheroids operate on the same basic principle. They are built to withstand an internal pressure to prevent evaporation loss when outside temperatures increase. This ability to withstand internal pressure also permits additional liquid to be pumped into the tank without evaporation loss. Hortonspheres and Hortonspheroids stop *all* evaporation losses as long as the internal pressure does not exceed the pressure for which the vessel was designed to operate.

Hortonspheres are built in capacities from 1,000 to 20,000 bbls. for pressure from 20 to 100 lbs. per sq. in. They are used for storing butane, isobutane, butadiene and other highly volatile products. Hortonspheroids are built in capacities up to 120,000 bbls. for storing slightly less volatile hydrocarbons. Write our nearest office for full details.

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Birmingham 1.....1534 North Fiftieth Street
Houston 1.....5618 Clinton Drive
Tulsa 3.....1607 Hunt Building
New York 6.....3345—165 Broadway Building
Cleveland 16.....2206 Guildhall Building

Chicago 4.....2125 McCormick Building
San Francisco 5.....1060 Rialto Building
Philadelphia 3.....1614-1700 Walnut St. Building
Los Angeles 14.....1422 Wm. Fox Building
Washington 4.....703 Atlantic Building

Plants in BIRMINGHAM, CHICAGO and GREENVILLE, PENNSYLVANIA

DETROIT PUBLIC LIBRARY

This is the first of a series of three advertisements discussing the economics of postwar remodernization.

For Your Refinery...

THERE'S ONLY ONE POSTWAR REMODERNIZATION PLAN FOR MAXIMUM PROFITS

... But Which One?

225 Broadway, New York 7, N. Y. • Jersey City, N. J. • 609 South Grand Ave., Los Angeles, Calif. • Philtower Bldg., Tulsa, Okla.
402 Esperson Building, Houston 2, Texas • Stone House, Bishopsgate, London, EC2

DESPITE *given crude sources* and *established markets*... refinery managements and their engineering staffs do not have a simple task in reaching decisions on postwar remodernization plans.

After due study of process recommendations and proposed capital investments . . . ticklish questions remain to plague. Is the plan sufficiently elastic to provide for envisioned product improvements? Does it provide the shortest pay-off period? Will current equipment be utilized to the fullest advantage?

It is here that the full scope of M. W. Kellogg's complete service is most appreciated—and valued—by customers. For this service embraces more than that of designer-builder. It shoulders the direct responsibility to the refiner of translating plant operations into maximum profits.

Supplementing and integrating the customer's management and engineering staff planning... Kellogg brings the full weight of its process design, pilot plant data, diversified outside commercial experience, and economic consultation services to bear on the specific problem involved.

Invariably, with increased profits as the goal, not one but several solutions present themselves. But for *maximum* profits . . . there is only *one!* For instance, in a recent case study, exhaustive analysis disclosed three different potentially profitable solutions.

Case A showed a 205% increase over existing yearly net credit... with a pay-out period for remodernization of 3.84 years—amortizing capital investment exclusively from the *increase* in annual credit.

Case B, on the other hand, showed an increase in yearly net credit of 263% (a further increase of 58%). In addition, it provided a shorter pay-out period—3.39 years—notwithstanding a 13% greater increase in capital expenditure.

Case C offered the same fundamental advantages as B . . . with a different choice of by-products.

Such detailed explorations of a client's problems demonstrate the responsibilities that M. W. Kellogg assumes over and above those of mere designer-builder. May we consult with you on your current plans?

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★**LABORATORIES**—fully equipped and staffed—devoted exclusively to chemical engineering and process development.

★**24-HOUR-A-DAY PILOT PLANTS**—17 refining processes operating continuously—providing accurate data for commercial scale application.

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dling of fuel. Some of the story of the development for military purposes of the portable pipeline idea is told elsewhere but that idea came logically and naturally from this study back through the 1930's of transportation of large and ever increasing quantities of motor and airplane fuel.

From designs for cans and drums, the study went to designs for tank trucks and tank cars, and in 1940 to pipelines and to bulk storage. As is told elsewhere this transportation officer in the spring of 1941 got authority from Congress and $100,000 to build a five-mile experimental line with pumps and telephone line complete. It was a success in North Carolina maneuvers and the Engineers were given the job of developing it. This they did at tests over the hills around the Shenandoah Valley.

Proves Expert in Organizing And in Delegating Work

When war came to the U. S. on Dec. 7, 1941, this motor transport officer tried to get special pipeline companies included in the original war plans. He was transferred to training and finally back to Motor Transport. In May of 1942 he was transferred to London as Motor Transport chief in the Transportation Corps, to help plan the truck part of the proposed invasion of Europe. Then it may be said he stepped out of the anonymity of the Washington Army staff and became the personality who has organized the European oil machinery, first headed it in London and then became its chief for this great Mediterranean area.

Here, therefore, is the place to introduce that personality, Col. G. H. Vogel, best known as 'Gus' but baptized Gustave. (*See front cover*). He was born in Nevada and raised mostly with the Indians for so long a time that he spoke the language of the Shoshones. From viewing all the rocky vastness of Nevada he became impressed with geology and by some quirk decided on oil geology. To that purpose he went for a year to the Colorado School of Mines.

Then the last war came and he had a chance to finish his education at West Point in a somewhat abbreviated war course so he took the appointment and has been an Army man ever since. He gave no more thought to the oil industry until he found himself heading up this oil work in Europe in 1942.

In addition to his years of studying and working on motor transport, Col. Vogel brought to his new job, or perhaps developed in it, a flare for organizing, for delegating work, supervising it and getting things done quickly and simply. Time and men have always meant money to him and money, because of his early frugal upbringing, has had to be worked for and is something to be conserved. He is big, six feet three inches and weighs 230 pounds and is constantly on the move. He just cannot sit still. So, given his opportunity in this new London post, he put all his energy into the task.

Few in Authority Aware Of Tremendous Demand

The picture that this background gives is necessary to an understanding of this European oil job and the machinery that did it because, at the start at least, few if any higher-ups in the Army and at Washington as well realized the tremendous number of mobile units the military would use nor, particularly, the vast quantity of fuel they would require.

Others in the Army and at Washington thought too much from previous experience when, to fuel their relatively handful of trucks and planes, they simply called up an oil company and asked that 10,000 gals. of suitable fuel be at such and such places on such and such days and the oil companies took care of the details. But such quantities were toy stuff compared with the 10 million gallons a day that are being consumed in this Mediterranean theater alone.

It also is necessary to understand somewhat the character of this personality—Col. Gus Vogel—and his place in this picture and to appreciate his tireless, yes tiring, energy in driving for bulk handling of fuel and to keep it simple lest it all bog down.

One must appreciate his personal force in order to understand how petroleum is seemingly handled by a well-knit organization while in fact it is not well-knit; to understand how the job has been done, despite the fact that there are many independent units, each really its own boss, concerned with oil handling, such as Quartermaster, Engineers, Transportation, Ordnance, Signal Corps, and many subordinate and allied units.

All these units have been caused to work together in excellent fashion and to a highly credible end but this has been done without the aid of any overall compelling power to command such as a top general has, or a White House 'directive' may give. In fact, the oil organization, such as it is, in the two theaters over here, has just grown as necessity seemed to require and as men came forward in it and took responsibility and got things done.

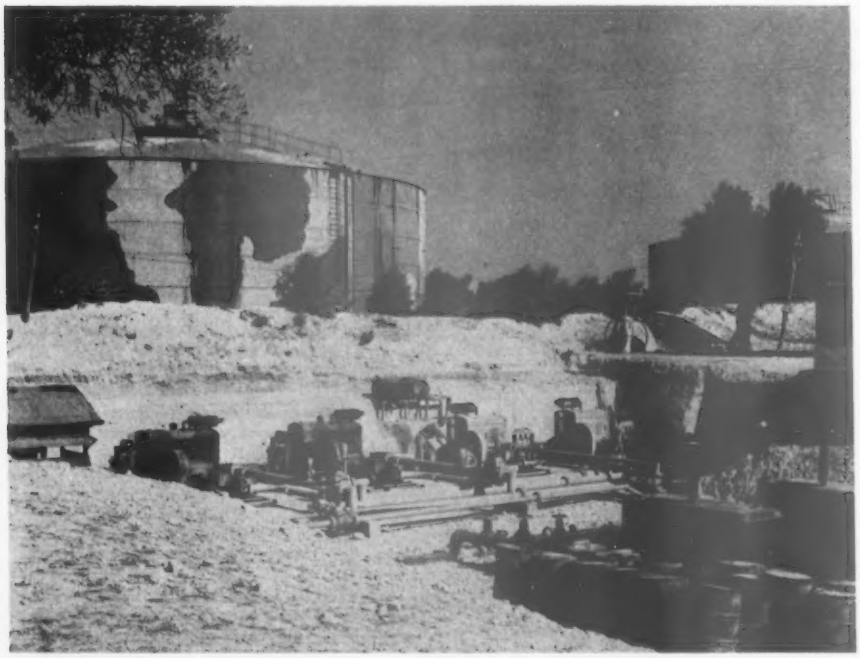
Outside of the success in supplying all the petroleum needed that has crowned their efforts, it can also be said that this trial and error growth has demonstrated many ways how petroleum products, that today represent at least 50% of all the maintenance tonnage of an army, should NOT be handled, as well as indicating some ways that it should be handled.

This war is too far along now to make any basic changes in the supply machinery of the Army but what has been done in oil to date should be an excellent chart on which to make plans for simplification and improvement in oil supply for the future.

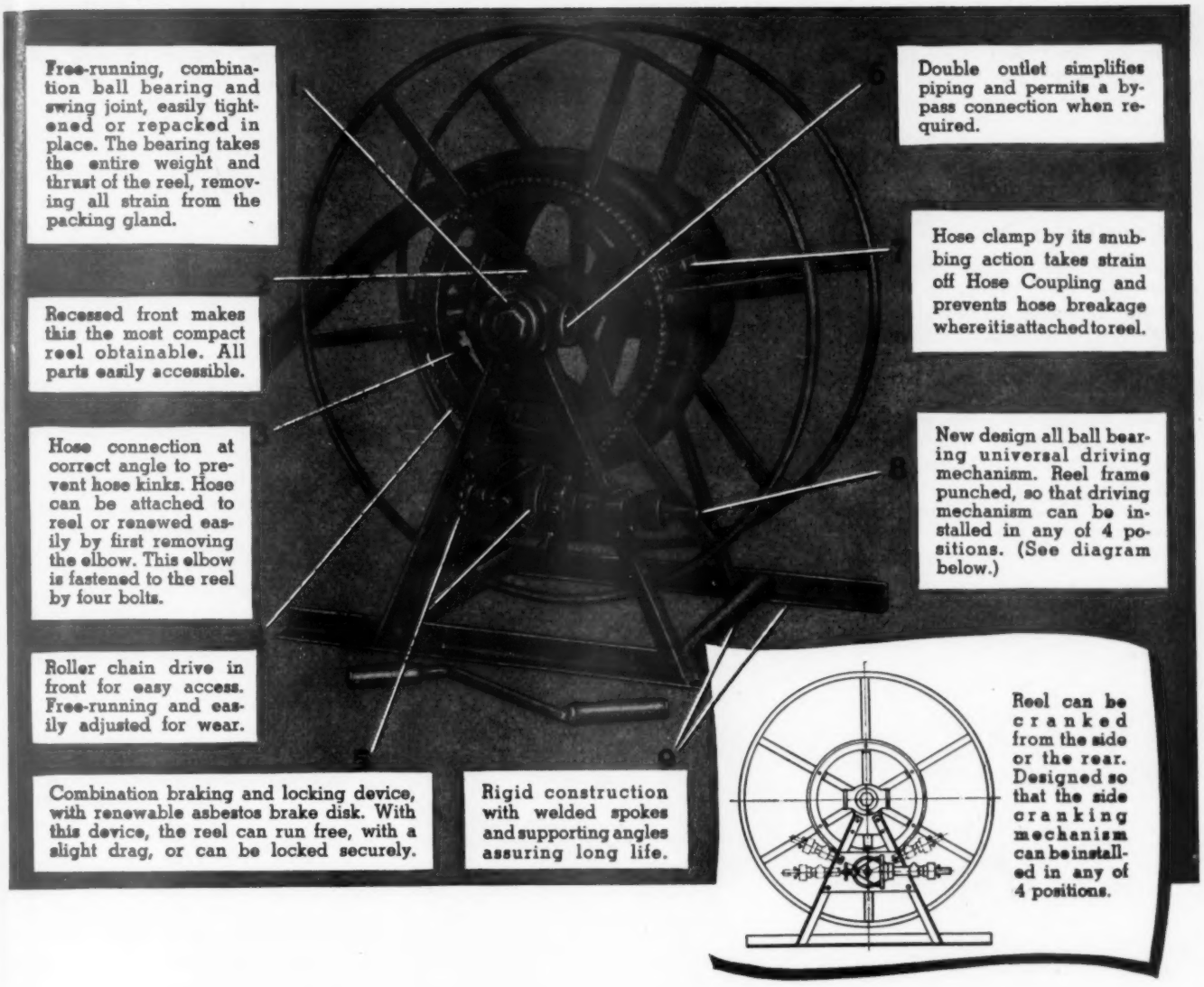
In London, Col. Vogel continued in his study of motor transport problems which meant that he continued his study of how to get fuel for a tremendous number of trucks and internal-engined fighting equipment.

He brought with him from the U. S. some of the staff he had earlier gathered on this first problem. One was an oil man, Capt. Richard Jones, of the Gulf Refining Co. Another was a telephone engineer who also had developed on motor problems, now Maj. R. R. Lovell, Purdue graduate and from the Bell Telephone Co. in Chicago.

There also was Capt. Adolph H. Graetz, motor transport consultant; Col. William C. Morgan of Detroit (he only recently got his eagles) who makes pis-



A four unit pumping station on a major Italian pipeline system. The tank "farm" consists of two 10,000 bbl. bolted tanks erected by special POL engineer troops


Free-running, combination ball bearing and swing joint, easily tightened or repacked in place. The bearing takes the entire weight and thrust of the reel, removing all strain from the packing gland.
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ton rings; Maj. L. J. Grunder, automotive engineer for Richfield Oil of California; now Lieut. Col. Coleman Romaine, ex West Pointer and automotive dealer of New Orleans; Lieut. Col. Sam Gorlick, lawyer with some oil law experience, from Rochester, N. Y. and Col. Webster Anderson, regular army.

Shift of Invasion Plans Complicates Problems

These men had first been selected because of their training in motor transport. As motor transport was the big problem in London, Col. Vogel brought them all over to keep on with that work. Hence these men just naturally continued with him and are with him today because the motor transport problem, for this group, easily switched over to one of oil transportation. The oil problem was theirs almost before they realized it and the invasion "D" days were right on them.

I won't take the reader through all the detail of this and that Army order but will just continue the broad picture and leave to the official Army historian the dates and organizations, etc.

In London the petroleum transportation problem loomed still larger when it was decided in the summer of 1942 to change the plan and invade North Africa first instead of France; Col. Vogel went to his chief, Gen. Thomas D. Larkin, for authority to cable to the U. S. for the experimental pipelines that had been developed and for authority to organize 'POL' companies. Even that early the U. S. Army adopted the British Army's designation of such units 'Petrol, Oil & Lubricants'. The cables were sent, an experimental line was installed in England and a POL company organized there while others were organized in the U. S., chiefly at Clairbourne, La. An American engineer skilled in pipeline construction was asked for by the Engineers and Lieut. Col. Charles L. Lockett was sent over and worked with the Vogel group. Col. Lockett found Charles G. Gholson, oil drilling contractor of Ranger, Texas, in an Engineer company and put him in charge of the first POL company. In that also was Tech. Sgt. J. R. Keany of Boston, no oil man, but he was developed with the Vogel group and today is a lieutenant in its AFHQ Section here.

Then the Army began shifting its organization around to try and find the answer to some of its problems. Against the protest of the Vogel group, Motor Transport was split up, maintenance going to Ordnance and motor truck operation going to the Transportation Corps but still nominally under the Quartermaster.

Nine services had their fingers in the gasoline supply. Gen. Lee, today commander of all the supply area in France, held a meeting in September 1942 as to what to do with gasoline supply. The War Department at Washington was silent on the subject, probably because, then and for at least a long time afterwards, it was blind to the size of the gasoline supply needs. Sept. 4, 1942 came instructions from the Army and Navy Petroleum Board, a comparatively new organization itself headed by now Admiral Nick Carter, former president of a big Shell subsidiary in the U. S.

These instructions called for the organization of an Area Petroleum Office in London to carry out the ANPB plans for exercising control of the procurement, shipping and allocation of petroleum supplies. Gen. Lee, a fast operating regular army executive, took the title of Area Petroleum Officer and told Col. Vogel to go ahead and do the work in his, Lee's, name.

Upsetting Prerogatives of Services No Easy Task

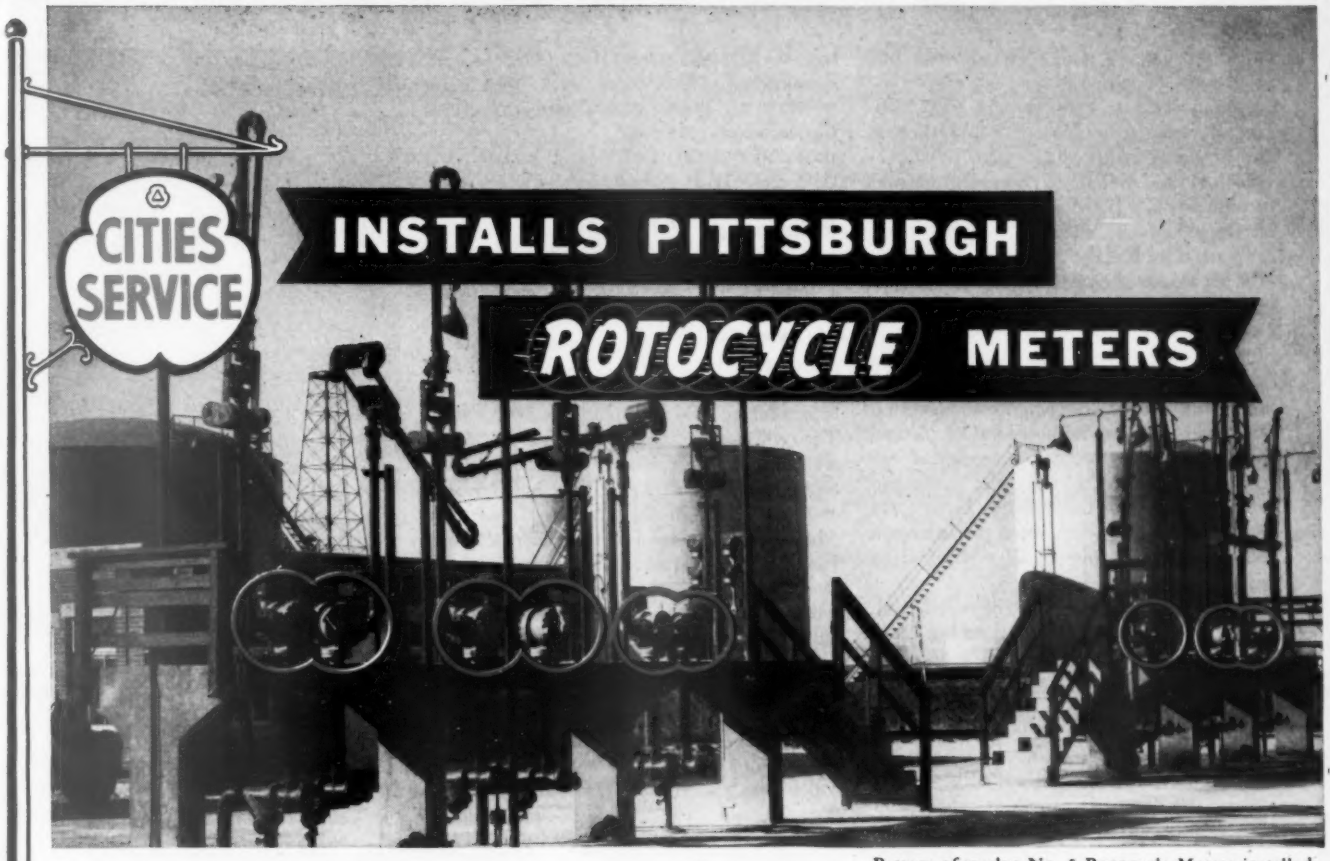
This work meant co-ordinating the planning and efforts of all the nine military services and many of them clung tenaciously (this is my comment from personal observation and I am not quoting Col. Vogel.—WCP.) to their prerogatives and did not open their minds very quickly to the tremendous volume of motor and airplane fuel that soon would be required by a 10,000,000-man army.

This also meant working out an efficient oil supply plan with the British which was done with the British Petroleum Board, set up by the British oil companies at the start of the war in September 1939, as well as working with an expanding petroleum section of the British Army.

During this period more men were added to the staff of the Area Petroleum Office to represent other Army units, particularly a representative of the air forces in Col. Bernard Johnson, former Texas company manager in the Far East, and himself a flier, and more men from the motor transport field.

When it was decided to invade Africa

To get sufficient depth of water for large tankers, something the Italians seemed to have overlooked when they built some of their oil terminals before the war, American oil men have strung a floating pipeline off the end of two docks in one seaport. Wrecks of ships sunk by both Germans and Allied air forces lie to the left of the tied up tanker



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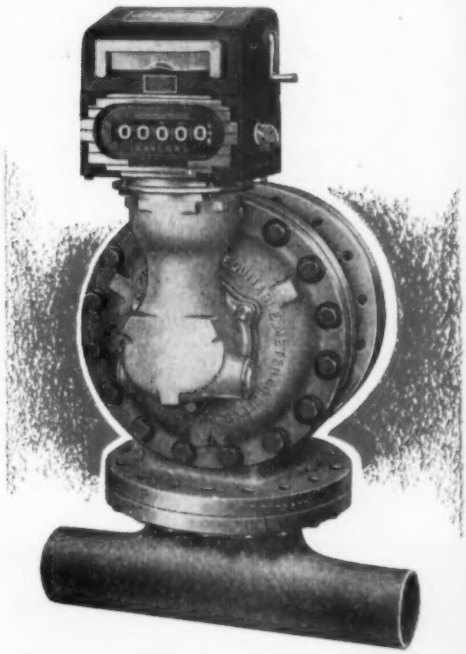

No. 5 Rotocycle Meter fitted with Master Meter Duplicator printing type register. Manifold shown with welding ends. Any type of flanged fittings can be furnished as connections.

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ahead of France, Col. Lockett was put in charge of pipeline and storage construction and rehabilitation; Col. Anderson was given charge of gathering the products, with Col. Vogel to supervise for the ANPB at Washington and to plan for ETOUSA—European Theater of Operations of the U. S. Army—and to plan also for the next job, the fueling of troops being assembled for the invasion of France then scheduled for 1943 but not made until 1944.

In October, with the North African invasion only a month away, Gen. Larkin, in charge of the Engineers destined for North Africa, borrowed Col. Vogel from Gen. Lee on the promise of returning him Jan. 1, 1943. Cols. Vogel and Lockett pushed the plans for North Africa all the harder, even to taking a chance and ordering tankers shipped in early convoys.

When the invasion convoys sailed, Col. Vogel was with them, landing at Oran Nov. 11, three days after "D"-day. Col. Lockett followed 13 days later, he having stayed behind to hurry up pipe and tanks for the pipelines.

The POL company that had been organized in England landed with the invaders and Capt. Gholson at once went to work repairing tanks in an old refinery of the Shell and getting his five-mile experimental pipeline ashore. This was later laid but used for water.

However, 50 miles of line were aboard the convoy and by "D-plus-5" days enough equipment had been put in shape so that a tanker that arrived on "D-plus-6" at a point six miles from Oran, was unloaded.

All the foregoing was done under continual bombing and sniping. As the oil installations were not close to the city of Oran they escaped serious damage but it was "most unpleasant" for the oil men and their crews.

In December, after the invasion, Col. Vogel told his superiors that his job was finished and that the work should be turned over to Col. Lockett and he, Vogel, return to London and to the Area Petroleum Office there. However, he was given a coal mine to whip into shape, and then sent on an inspection trip to Tunisia where Gen. Gale, Gen. Eisenhower's right-hand man, told him to stay in North Africa and represent the supreme command in oil for at least six more months. Col. Vogel is here yet.

Pet Section Organized at Meeting of 'Customers'

After this assignment from Gen Gale, a meeting of the interested oil "customers" was held in Gen. Gale's office and the Petroleum Section was organized under the then new Allied Force Headquarters with Col. Vogel in charge as representing the commander of AFHQ. The whole Mediterranean area for both armies was put under this PET SEC including the U. S. Army that had landed at Casablanca on the Atlantic Coast and which was known as the Western Task Force. That Army had come straight from the U. S. and had its own petroleum setup under the charge of Lieut. Col. Harry McCobb of the Standard Oil Co. of New Jersey and now a member of the ANPB in Washington.

Col. Vogel started his PET SEC for AFHQ Dec. 26, 1942, when given his instructions by Gen. Gale but the official order was dated Feb. 3, 1943. By then the Colonel was moving right along.

This PET SEC organization order provided in brief—

That all petroleum coming into the theater would be handled as a common pool and drawn on by all armies, British, American and French and civilian agencies as allowed by AFHQ;

That PET SEC be the sole agency to gather estimate of needs and order and import supplies for the area and communicate with the sources;

That it direct ships and all movements and tonnage;

Plan for future military operations as to supplies and oil, handling facilities.

Co-ordinate all bases and agencies handling and using petroleum;

Maintain local control groups to decentralize functions of PET SEC;

Organize and maintain a Technical Service and testing laboratories and direct them.

This setup was weakened a bit by some subsequent orders and interpretations by different groups but was later on strengthened. While the whole oil machinery has not been drawn into one unit and put directly in its entirety under the command of one officer, it can be said that there has been a gradual tightening of authority that if not vested directly in the chief of the Petroleum Section, at least is dominated by his advice to the high command of AFHQ.

Automatic pressure controls govern the speed of pumps on the gasoline lines, so attendant does not have to sit in front of his gauges every minute

Col. H. B. Eyles, petroleum section, AFHQ, is chief of the section at Rome

But over all the complexities and difficulties of this Army setup there has been, one might say, the compelling influence of the real worth of the service being rendered the armies by PET SEC, by the oil and other men who constitute it and by the chief, Col. Vogel.

The PETROLEUM SECTION of AFHQ consists of its chief, Col. Vogel and his staff over which the Colonel has full veto power. The staff is divided into groups:

Procurement of requirements—Provisioning.

Transportation—routing of tankers and tank cars.

Technical—checking on complaints against products, keeping tab on proper use of products, inspection and testing with laboratories.

Plans and Operations—anticipating need for new installations and pipeline and storage facilities, planning them and checking on operations of existing facilities.

In a nutshell the job is to foresee all requirements, to get the equipment ordered and installed, or order in the supplies and to cause each handling and using unit to do its job in connection with the whole plan even though PET SEC may not be able to step in at a given point and order a specific thing done by a certain officer or his unit.

Whatever there may be in shortcomings of authority PET SEC still has to see that the right job is done and on time by working around the Army's rather complicated setup and within its operating rules and practices.

The British Army, which is represented in all the activities of PET SEC, including a deputy chief, has a much tighter setup with absolute authority over all petroleum handling running down from a deputy director of its Supply & Trans-

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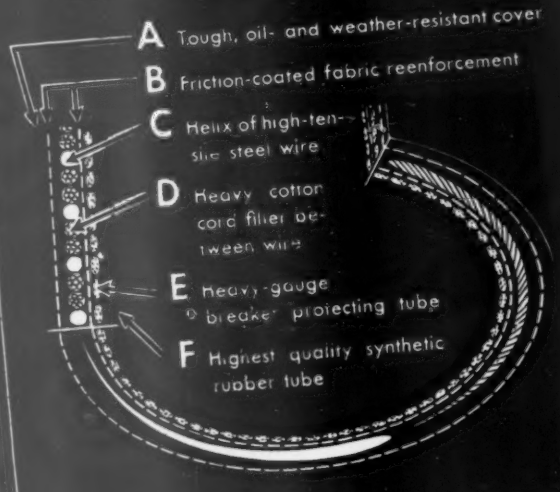
A Tough, oil- and weather-resistant cover
B Friction-coated fabric reenforcement
C Helix of high-tensile steel wire
D Heavy cotton cord filler between wires
E Heavy-gauge breaker projecting tube
F Highest quality synthetic rubber tube

GOODYEAR

portation services, through a colonel entirely in charge of oil.

Various operating units are loaned to the British Petroleum Service, but once under that service they are controlled by direct authority from the S-T-2 officer who does not have to go through the heads of each respective service—"through channels" as they call it in the U. S. Army.

U. S. Army Use of Pipelines a New Idea in War; First Tests Were Made in 1940 Maneuvers

NAPLES, Italy—Here are some facts from Army records of the adaptation of pipelines to military supply of gasoline in battle areas. These may not be all the facts of importance in this new use of pipelines but this is the story as the Army knows it according to the records available in Europe. The search of these records of both American and British Armies, was made by a Britisher charged with assembling from reports of both armies, the worthwhile facts of the invasion of North Africa.

The Motor Transport Division of the Quartermaster General's Office in Washington, D. C., began considering some time in 1940 how to get gasoline in the necessarily large volumes to the large fleets of trucks and armored equipment that war would call into use. The result of the many discussions and conferences was that the War Department included in its budget submitted to Congress in February 1941 a request for a special appropriation of $100,000 to build and operate an experimental portable pipeline with pumping equipment, the line to be about five miles long and to be used at forthcoming Army maneuvers.

The appropriation was allowed after the House Appropriations Committee had heard the proponent of the scheme, an Army officer who is, one might say, anonymously identified in the Army's records as afterward being Petroleum Officer for the Mediterranean Theater. Orders for the pipe and equipment were given in May and June of 1941, delivery was made Aug. 1 and the line was built in North Carolina where the maneuvers were carried on.

First Tested With Water

It was tested out with water, as the pumping of fresh water to the armies, especially in desert country, was one of the purposes of developing pipelines. The line was then used to fuel the mobile equipment in the North Carolina maneuvers, the fuel being pumped direct from tank cars on sidings into the line, five miles across country, streams and ponds, to nose-and-nozzle equipment for delivery directly into tanks of the consuming vehicles and into cans.

This line consisted of 3 in. pipe bought from Republic Steel Co. with various kinds of small pumps and gasoline engines.

The idea worked and Army officers concerned approved. The idea was submitted to the Engineers to work out in connection with water supply as well as to further develop the mechanics of the pipeline construction and operation.

Getting aid and succor to the hard-pressed Chinese Army was under study at the time and one of the plans considered was getting gasoline to the Chinese up the famous Burma road. In September 1941, the idea of laying a pipeline up this road to Lashio was under consideration and an oil industry construction and pipeline engineer was called in by those interested.

In the meantime the Engineers were prosecuting their study and in the summer of 1942 they built 22 miles of 4 in. pipeline with portable pipe and equipment in the Shenandoah Valley of Virginia. This was finished in July 1942 and also proved practicable.

Special Pipeline Company Trained

In June 1942 members of the Army's Motor Transport Section of the Transportation Corps, came to London to start planning for the invasions of the Continent. It was still their responsibility to fuel the mobile equipment as well as to operate the trucks. As the Motor Transport Section had first inaugurated the idea of military adaption of pipelines for gasoline, Washington was asked in July 1942 for a competent oil industry engineer who understood pipelines.

That engineer was selected, commissioned, and flown to London and began the planning of portable pipelines in connection with the proposed invasions, first, then of France, and second of North Africa.

Company "A" from the 347th Engineer General Service Regiment was chosen to be trained as a special pipeline company, and on Sept. 17, 1942, it

Repackaging 'Gas' Supplies on 7th Army Front

Signal Corps Photo

Some of the gasoline for the Army is shipped from base supply by railway in drums. These shipments have to be repackaged into 5-gal. jerrycans for the fighting front. Drums are unloaded from freight car (rear) and rolled up to the catch basin in the foreground. This photo was taken in the Seventh Army Area, France

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was "activated" as they say in the Army, that is, it got its official order on that day to be this new type of company.

In the meantime, the original five miles of 3 in. pipe and its pumping equipment, acquired in the summer of 1941 and used in North Carolina, was brought to England for this new POL company to practice with. England was scoured for more pipe and equipment and, as further plans could be blue-printed, orders were placed for a total of 300 miles of 4 in. pipe for delivery at the rate of 50 miles a month starting Nov. 1, 1942, and 200 miles of 6 in. for delivery between November 1942 and March 1943. All this pipe was to be victualic type.

When the first pipeline company sailed from England in the convoy scheduled to land in Algiers on "D-plus-3" day—November 11, 1942, it had with it the first 50 miles of military pipeline. This was laid in North Africa from Oran, Algiers, to a tank farm of 21,000 barrels in four steel bolted tanks, at Tafaraoui, 24 miles inland and, with the tank farm, was finished and the pumps started Jan. 8, 1943. The construction would have been considerably sooner but for heavy rains. This was the first military pipeline to be put in war operation.

Some Additional Facts Added To Supplement Army Record

So much for the plain facts as given by Army records. As Army reports seldom identify individuals by name, inquiry from reliable sources has developed the following information:

The early discussions on the possibility of adapting portable pipelines to military supply of motor fuel took place in the Motor Transport Division, O.Q.M.G. in Washington, early in 1940, were initiated by Col. G. H. Vogel, then a lieutenant colonel and plans chief of that division, Maj. Richard Jones, formerly of Gulf Oil Corp., Col. McNary of Standard of New Jersey, and Lieut. Neis, then on duty at Holabird Q.M. Depot.

At that time the procurement of all the Army general purpose trucks and the ground POL was a responsibility of the Motor Transport Division of the O.Q.M.G. As Col. Vogel, now Chief of Petroleum Section, AFHQ, estimated the possible size of the next Army and of the war's operations he became more and more impressed with the tremendous size of supplying its mobile equipment with motor fuel.

He saw that in a war in Europe it would not be possible to call up a few of the oil companies near the scene of operations and tell them to have a couple of hundred thousands of gallons of gasoline on hand at a certain place and on a certain day, and the oil companies would do the rest.

This had been the procedure during all the maneuvers ever held in the U.S., including the last in Louisiana at the start of our entry in the war.

Col. Vogel saw that there would be more mobile equipment in and.behind one fighting Army than there might be in one or several of our most populous states and that when they were on the move they would consume fuel at a far greater rate than most trucks in peace-time service.

Further, the Armies would be on the move, maybe 50 or 100 miles on down a country, or a coast, in a few weeks or months time, a country perhaps devoid of any amount of oil storage and transportation equipment. He also saw that to fuel that equipment from cans and drums would call for millions of such containers which would take a small army in itself to fill and move and empty.

All this was discussed by Col. Vogel and Maj. Jones and others with the result that the oil industry's system of handling large quantities of oil in bulk through pipelines was considered plus the oil industry's practice of three quarters of a century of laying its small lease and plant lines on the ground, lines that could easily be moved about with light pumping equipment.

From these discussions came the decision of the Quartermaster to ask for an appropriation for a trial pipeline, and Col. Vogel was the man who explained the request for $100,000 to the Congressional committee.

The engineer who was called to London by plane from the second experimental pipeline built by the Army's Engineers Corps and who had helped plan the proposed Burma pipeline, was Charles L. Lockett, now a lieutenant colonel on pipelines in COM Z ETOUSA in France. Since that flight to London he has supervised the building of many of the pipelines in the Mediterranean area including the latest line in Southern France. (*See NPN front cover, March* 21, 1945). Prior to coming with the Army Engineers he was a construction and consulting engineer particularly on pipelines in the U.S. with headquarters at Houston and New York.

Many others have contributed to and been associated with this development of military pipelines but the above, from Army records, seem to be the basic facts. —W.C.P.

(NEXT WEEK—Mr. Platt tells about the pipeline which supplies the mammoth Foggia airfield.)

Bulk of Aviation Plants Can Be Converted Quickly to 85-90 Octane, Says Bruce Brown

NPN News Bureau

CHICAGO — The bulk of new refinery equipment now used in producing "more than 500,000 b/d" of 100-octane gasoline for war can be converted almost overnight to production of 85-90 octane fuel for civilian use in automobiles, Bruce K. Brown, former assistant deputy to PAW, told a conference of Chicago technical societies at the Stevens Hotel on Mar. 29. Mr. Brown is now a director of Standard of Indiana in charge of research and development. The postwar fuel of 85-90 octane rating would be far superior to prewar gasoline used in automobiles, he said.

Quoting figures supplied by Paul Ryan, he said that airline executives estimated that all Pullman passengers, mail and express carried by the railroads in 1939 would require only about 50,000 b/d of aviation gasoline if carried by plane instead of by rail. Thus, he indicated a possible reduction in demand for aviation fuel in peace time to 1/10th of the war time requirement of 500,000 b/d.

"On this basis," he continued, "it seems extremely improbable that all the nation's facilities for making aviation gasoline could be continued to be devoted to that use and suggested the conversion to manufacture of 85 to 90-octane fuel for automobiles. He said that more than 90% of the facilities for production of 100-octane were in this country, and that, while some had been critical of the depletion of our oil reserves, this concentrated production of a vital munition of war in our own hands.

Dr. Gustav Egloff, director of research for Universal Oil Products Co. was chairman of the oil panel at the conference, which took in a variety of subjects from foundry practices to electronic controls. Other speakers on the oil panel No. 17 were: Dr. Charles I. Thomas, also of U. O. P., who spoke on catalytic cracking; Dr. V. I. Komarewsky, professor of chemistry at Illinois Institute of Technology and consultant of the Institute of Gas Technology, whose subject was "Production of Synthetic Fuel from Natural Gas"; William Mendius of the development department of Sinclair Refining Co., who talked on "Alkylation—Backbone of Aviation Gasoline."

Dr. Thomas said that chemists and chemical engineers were still working together to find the combination of charging oil temperature, pressure and catalyst which will give the highest yield of 100 plus-octane fuel.

In his discussion of alkylation, Mr. Mendius said that 130,000 barrels of that product was now being produced daily. In its manufacture, he said, sulfuric and hydrofluoric acids, two of the strongest in the chemical category, are used. He added that research had developed construction materials to withstand the acids and determined the proportions of gases and acids and the temperatures and flow rates giving the greatest amounts of alkylate.

Dr. Komarewsky pointed out that, next to petroleum, natural gas is our largest fuel resource, and its conversion to gasoline is a problem of primary importance in our national economy, both in war and peace.

"By interacting natural gas and steam with special catalysts," he said, "mixtures of carbon monoxide and hydrogene are produced which react further when other catalysts are used to produce gasoline, Diesel oil and paraffin wax. The octane rating of the gasoline is increased by further catalytic treatment," he added. "The Diesel oil is of excellent quality as produced."

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MEARLFOAM-5 yields the live, lasting foam with the tough, elastic water-retaining film. The U. S. Navy uses this effective multi-protein foam extensively for preparedness—and for quickly extinguishing fires on shipboard and at shore bases. When split-seconds count — you can rely on MEARLFOAM-5 to put fire out fast—keep fire out, *permanently!*

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Duke to Ask Subsidy for All East Coast Transporters

NPN News Bureau

WASHINGTON—A plea is scheduled to be made to Congress soon that East Coast oil transportation subsidies be paid by DSC to all companies importing to Dist. 1 regardless of compliance with PAW Directive 59, PAO5, or other non-DSC government regulations.

The recommendation will be made by Southeastern Oil headed by Gordon Duke, when hearings get under way before the House Banking and Currency Committee on S 502 (authorizing expenditures by DSC amounting to $290,000,000 for oil subsidy program during fiscal year ending June 30, 1946) which passed the Senate on March 15. Hearings before House group are due to start shortly.

If and when Southeastern appears before the committee, the company is expected to base its recommendation, on the contention that PAW Directive 59 is purely voluntary and that the withholding of transportation subsidies to any company operating outside Directive 59 makes that regulation compulsory, which is unfair and discriminatory.

Oil Transporters of 48 States To Outline All-U.S. Parley

NPN News Bureau

WASHINGTON—Forty-eight petroleum transport leaders, one from each state, will meet April 16 and 17 at the Hotel Sherman, Chicago, to discuss plans for formation of a nationwide tank truck conference. The proposed conference would include all over-road tank truckers, not just petroleum transporters.

Letters are now coming in to American Trucking Assn.'s headquarters in Washington and to Clark Sergeant—who will serve as chairman of the Chicago session—in California, suggesting topics for discussion.

Meanwhile, several of the 48 leaders are holding regional conferences to get a nationwide cross-section of oil transporters' views on the proposed joint tank truck organization, which was discussed at a meeting in headquarters here last month.

In addition to planning a nationwide tank truck conference, the question of whether the group should be affiliated with A.T.A. or be independent, also will be discussed.

Arabian American To Build $125,000,000 Line In Arabia 'Within Five Years,' Says Duce

NPN News Bureau

NEW YORK — Arabian American Oil Co. is planning a pipeline "within five years" that will cost approximately $125,000,000, extend from the Abqaiq field in Saudi Arabia to the Mediterranean, and may have a capacity of 300,000 b/d. This was the tentative program revealed last week by James Terry Duce, vice president of Arabian American, during a brief visit to New York.

Mr. Duce flatly refused to predict when construction on the pipeline, which may entirely transform the course of oil products distribution in Europe, will be started. It will probably be built as a private project by Arabian American, which is jointly owned by The Texas Co. and Standard Oil Co. of California, and will occupy the function of the line which Interior Secretary Ickes proposed last year be financed with Government funds.

James Terry Duce . . . "We've billions of bbls. of oil."

"We're going to build the line," Mr. Duce said, "but we don't know when or how. We've billions of barrels of oil in Saudi Arabia, and this is the cheapest way to get it out for whatever business we have westward of Suez."

He explained that his estimate of $125,000,000 for the cost of the line was necessarily tentative, since the total will depend on wages and when it can be financed and materials are available. No conclusions as to means of financing have yet been reached, Mr. Duce said, although rumors persist here that Government funds may yet be made available for the purpose.

Would Stretch 1000 Miles

The Abqaiq field, from which the line would stretch more than 1000 miles to the Mediterranean, is the southernmost of three areas presently yielding more than 40,000 b/d. The Arabian and Bahrein subsidiaries of the company are now producing more than 60,000 b/d. H. D. Collier, president of California Standard, recently said that production will be increased to approximately 120,000 b/d late this year to meet requirements of a new refinery being built at Ras Tanura by Arabian American and the refinery of the Bahrein Petroleum Co. on Bahrein Island, which has been recently expanded to handle more than 60,000 b/d.

The Arabian American's major fields, in addition to the Abqaiq, are the Abu Hadriya and the Dammam, all in concessions covering 440,000 square miles on the west side of the Persian Gulf.

The terrain over which the pipeline will be built rises to an elevation of 2600 feet. The line itself will be 24 and 26-in., and would require about 11 pumping stations to reach the 300,000 b/d capacity, Mr. Duce said.

A few months ago a party of engineers headed by Burt E. Hull, president of Texas Pipe Line Co., surveyed several possible routes for the proposed pipeline and, according to Mr. Duce, found a "number of points" on the Mediterranean coast where the line might advantageously terminate.

May Yield 20 Billion Bbls.

Arabian reserves are ample, Mr. Duce declared.

"There are about 5,000,000,0000 barrels oil reserves in the Arabian fields we've already discovered," he said. "We'll be almost certain to find 10 billion barrels eventually and we'll probably find 20 billion." (The 20 billion figure approximates existing proved reserves in the U. S.—Ed. Note.)

He pointed out that there is a distinct difference in the character of geologic formations in Iran and Iraq and in Saudi Arabia.

"The formations on the east of the Persian Gulf and in northern Iraq are of the tertiary age," he said. "West of the Gulf, production is cretaceous-jurassic: the same as in East Texas. Production in the Kuwait area is from sand. Practically all else in this section is from limestone.

Supply Military Needs Now

"Producing problems on the two sides of the Gulf are quite different, although all areas have normal pressures, considering their depths. The folds on the west side have a gentle decline."

Mr. Duce believes that the Middle East will probably supply crude and oil products to Europe after the war, although "there is even a possibility that the U. S. will also import from the Middle East."

Arabian American Oil Co. employs about 1000 Americans in Saudi and on Bahrein. In addition there are 1200 Italians who formerly lived in Eritrea and between 10,000 and 12,000 Arab workers.

"The full extent of the reserves" of

Emblem of all-truck stamina, of rugged dependability and economical operation! Yes, the International Triple Diamond trade-mark at left above is the identifying mark on powerful trucks—trucks that faithfully hauled raw materials and finished goods for America at peace . . . that haul raw materials and finished products for America at war . . . that are fighting instruments in the hands of fighting men on Allied fronts everywhere.

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International Harvester products are a family—trucks, industrial power, farm tractors and farm equipment. A new symbol to identify the family *as a family* has been chosen—the IH at right above. This symbol does not displace the Triple Diamond on International Trucks. It means Product of International Harvester—vital, basic and essential to America at war and peace.

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THE FINE performance of Wayne Pumps during the long, hard years of war has offered conclusive proof of Wayne's claim: "There's $50 Greater Value in a Wayne" . . . the extra value of better design and construction that pays off in years of trouble-free service far beyond normal expectancy. Wayne Pumps are faithfully measuring and computing accurately as always, even after millions of gallons have been pumped through them, and they're ready to keep on pumping for the "duration" and more. Where service has been necessary, Wayne's Nation-wide Service Organization has been on the job.

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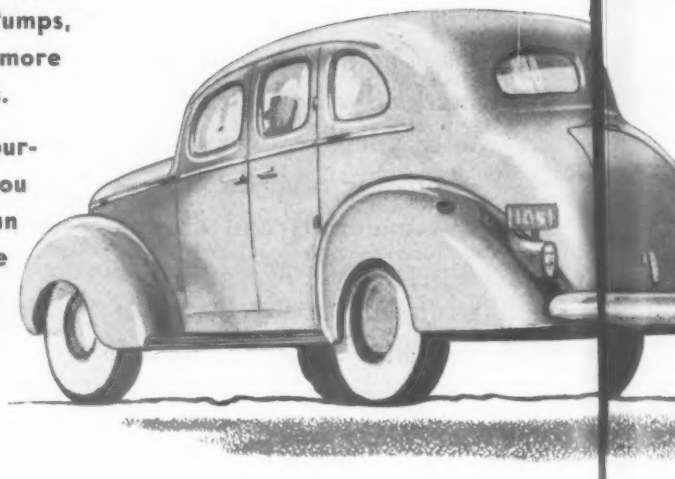
When happy days are here again and you may purchase service station equipment, we believe that you can select Wayne Pumps with greater confidence than ever because of this war experience. Our postwar line will be complete with Air Compressors, Car Washers, Air Scales, Hose Reels and Lifts as well as Service Station Pumps. It's the time to plan, now. Write for new pump bulletin today.



ARMY E NAVY

THE WAYNE PUMP COMPANY ★★

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Arabian American has not been determined, Mr. Collier said in his recent annual report to stockholders of California Standard.

"The region east of Suez is a natural outlet for products of the Persian Gulf operations," he continued. "Marketing activities are carried on by the California Texas Oil Co., Ltd., also jointly owned by Standard of California and The Texas Co. This marketing company or its subsidiaries operate in Egypt, Africa, India, Australia, New Zealand, China and the Philippines.

"At present the products are largely consumed by the armed forces of the United Nations. The producing, refining and transportation facilities that have been expanded during the war will be available to supply Mediterranean and European needs after the war. A pipeline from the Persian Gulf to the Mediterranean Sea, which is under consideration as a future project, would serve to bring Arabian oil to the consuming areas west of Suez."

Reports More States End 'Gas' Tax Grab

NPN News Bureau

CLEVELAND — Asserting that the folly which attends the diversion to non-highway purposes of state funds obtained from taxes was receiving nation-wide recognition, B. H. Markham, director of the A.P.I.C., last week reported that legislative action thus far in 1945 by several states would add to the number that are prudently preparing for the highway future by safeguarding the funds designated for road construction.

"The trend to eliminate the grabbing of the motorist's tax dollar shows an increasing awareness of the part of the people for the need of anti-diversion amendments," he said. "Decided progress along this line was emphasized when Pennsylvania recently gave approval to an amendment designed to end diversion and it will be submitted to popular vote at the next election. Kentucky has taken similar action and its amendment will go before the people in November.

Cites Missouri Action

"Indiana and Tennessee have both acted on anti-diversion amendment with first passage in the legislatures. The overwhelming majorities indicate that the second passage will receive the same enthusiastic support. With Gov. Baldwin endorsing a similar measure in Connecticut, there is no doubt that it will pass in that state."

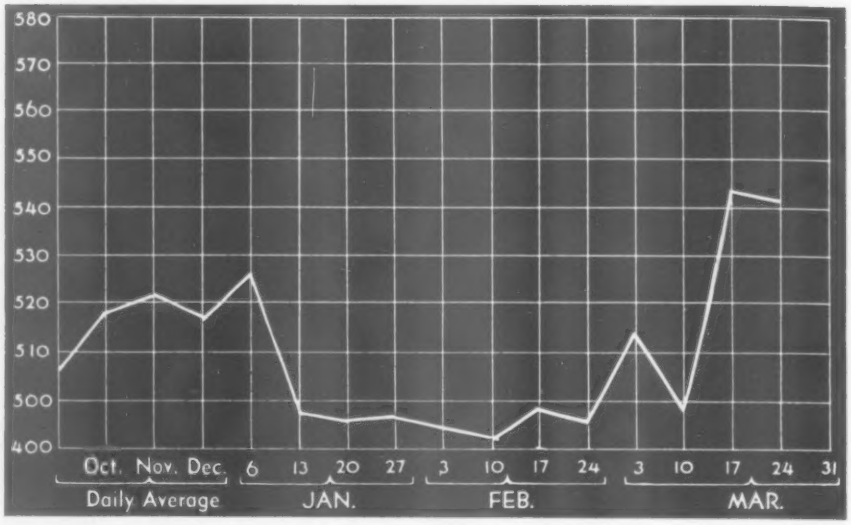
Another strong factor in progress cited by Mr. Markham was the provision of the new constitution accepted in Missouri which provided for the continuance of anti-tax diversion. "This policy has been in force since 1928 and the results have proved the wisdom of such course," he said, and continued:

"This nation-wide trend toward safeguarding highway funds by the passage of anti-diversion amendments is gaining increasing momentum. States having adopted such constitutional amendments now include California, Colorado, Idaho, Iowa, Kansas, Maine, Michigan, Minnesota, Missouri, Nevada, New Hampshire, North Dakota, Oregon, South Dakota, Washington, and West Virginia.

"The American people are becoming increasingly aware that diversion of automotive tax funds is a serious threat to highway progress in the United States. In many states the practice substantially reduces the amount of funds available for highway construction. In 1941, the last peace year, the states as a whole diverted an amount equivalent to 60% of the total state funds spent on main state road systems in that year. In recent peace years many states diverted amounts of gasoline taxes and motor vehicle registration fees that exceeded their federal highway aid grants. Thus, it would appear that in some states the practical value of federal highway aid is largely to replace automotive tax funds that have been diverted to non-highway purposes.

"If America is to make progress in highway development after the war, there must be recognition of the urgent need to eliminate now the unsound practice of the diversion of state automotive tax funds to non-highway purposes," Mr. Markham concluded.

Tank Car Hauls to East Drop 4922 b/d



NPN News Bureau

WASHINGTON—Tank car loadings to Dist. 1 in the week ended March 24 averaged 541,525 b/d, off 4922 b/d from the previous week. Actual number of cars loaded was 17,604. Shipments by companies were as follows:

Allied Oil Co., Inc.	87	Franklin	2	Republic	136
Allied Oil Corp. (Ill.)	22	Freedom Oil	2	Richfield	145
Amsco	121	Gulf	1690	Root	31
Arkansas Fuel	105	Hartol	158	Royal Petroleum	77
Ashland Refining	186	Hess, Inc.	10	Shell	1116
Asiatic Petroleum	14	Home Oil	12	Sinclair	393
Atlantic Refining	816	Hunt	7	Skelly	18
Bell Oil & Gas	4	Industrial	7	Socony-Vacuum	1548
James B. Berry Sons	13	Jenny Mnfg. Co.	135	Southland	1
Cantelou	32	Libby	2	Southport	18
Chalmette	23	Maritime Oil	24	S. O. California	2
Champlin	92	Mid-Continent	18	S. O. Indiana	517
Cities Service Oil Co. (Pa.)	327	National Refining	35	S. O. Kentucky	66
Cities Service Oil Co. (Del.)	49	Pacific	47	S. O. New Jersey	3240
Continental	20	Pan American	991	S. O. Ohio	470
Cooperative GLF	19	Petroleum Corp.	25	Sterling	9
Cosden	58	Petroleum Heat & Power	5	Sun	1786
Crown Central	18	Phillips	475	Talco	8
Daugherty	18	Premier	39	Texaco	1778
Drake	9	Primrose	19	Tide Water	94
Elk Refining	57	Pure	294	Tiona	3
				Triangle	18
				Wood River	43

Fairer Truck Legislation Gaining, Fruehauf Says

Special to NPN

DETROIT—There is a marked trend toward more liberal legislation governing motor transport, Roy Fruehauf, executive vice-president, Fruehauf Trailer Co., said here last week.

"People are beginning to realize that the way they can secure an adequate return for their investment in good highways is to permit these highways to render the service of which they are capable", Mr. Fruehauf said.

"Interstate barriers, restrictive load and length laws, and particularly non-uniformity of regulations in neighboring states have cost the public dearly over the last two decades", he added.

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To suit that taste, 7 years of continuous reader-research have been conducted to find out which subjects this audience likes best. As a result, Redbook is a sure-fire show for this audience — a feast of good reading, not just with one or two stories, but from cover to cover.

No other show, no other magazine or group of magazines holds the interest of Redbook readers to anything like the same degree. No other assembles these 1,500,000 Redbook readers as a cohesive audience.

So in Redbook — and only in Redbook can your advertising be sure of dominating this 5 point audience of 1,500,000.

Isn't this Redbook audience well worth dominating? Especially since all it costs is $37,200 for a full page in every issue!

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While space in Redbook is sold out at present, we'd like to send you "The Rating You Can Expect in Redbook." Write Redbook, 230 Park Avenue, New York 17.

A Distinctive Show

Six million — the size of a modern army: One out of every 5 U. S. families read Redbook, Cosmopolitan, and American, THE MONTHLY GROUP — with less than 15% duplication. Literally, an army of people for your advertising to command — at a cost of $160,000 for 12 full pages in all 3 magazines.

REFINING NEWS and TECHNOLOGY

Lists 8,000 Alien Patents Open to U.S. Citizens

NPN News Bureau

CLEVELAND — A complete list of 8,000 chemical abstracts appropriately indexed is available for $25 through the Office of Alien Property Custodian, Chicago 3, Ill., a recent announcement by that agency says.

The release says that short descriptions and drawings of 37,000 mechanical and electrical patents have been prepared. At the outbreak of the war, some 45,000 United States patents and patent applications were seized from enemy aliens and nationals of occupied countries. Licenses under most of these are now available to United States citizens for an administrative fee of $15 per patent. About 30,000 of the patents are of German origin. Many of the remaining are Italian and Japanese. They cover practically every field of mechanics, electricity, and chemistry.

Copies of the actual patents themselves may be seen at the office of Alien Property Custodian, Field Bldg., Chicago; 120 Broadway, New York City; 17 Court St., Boston; National Press Bldg., Washington; Guardian Building, Portland, Oreg.

Asks Uniform State Definition On Kerosine and No. 2 Oil

NPN News Bureau

WASHINGTON — PAW this week made public a request of Deputy PAW Davies calling on the state and local governments to adopt, for the duration, Federal specifications for kerosine and home heating oil.

In letters to governors of the 48 states, Mr. Davies said that adoption of the same minimum flash points as have been set by the Federal specifications executive committee—115 deg. F. for kerosine and 110 deg. for No. 2 fuel oil—would materially assist the war program and "help us to solve a difficult supply problem next winter."

He explained that varying state and local standards have created technical production and transportation problems with the result that the amount of both products that can be made available has been reduced.

Ryan Gives Details on New Process Converting Natural Gas to 75 Oct. Gasoline at 5c a Gal.

Natural gas can be converted into high quality motor fuel by an already developed process, at costs, under sound economic conditions, competitive with those of present refining processes.

The process also can produce high Cetane number Diesel, fuel and also provides an economical source of selected chemical compounds, stated Paul Ryan, vice president, M. W. Kellogg Co., New York, refinery engineers, in discussing this company's new Synthol natural gas conversion process.

"It can have a present appeal to those companies which have adequate gas reserves located close to oil refineries, contiguous to economical transportation and whose managements are realistically mindful of the economic problems, not only of manufacturing chemical compounds but also of their profitable distribution," he stated. Mr. Ryan's statement on the Synthol process follows:

By Paul Ryan

The war-stimulated development of technological processes has made no greater advance than in the petroleum industry. The utilization of various peacetime gaseous by-products from a petroleum refinery to make chemical components of wartime products (aviation gasoline, synthetic rubber, etc.) has accelerated the conversion of the average petroleum refinery into a potential postwar chemical plant.

Excessive drafts on the petroleum reserves of this country to satisfy unprecedented wartime demands for petroleum products have emphasized the fact that

Paul Ryan . . . explains Synthol process

the U. S. has been providing annually over 70% of the world's supplies of petroleum from 15% of the proven oil reserves and from 25% of the world's potential oil reserve. Wartime cries of "shortage of oil" arose, and some fears were stimulated that wartime demands would produce exhausted postwar petroleum reserves.

Petroleum is an exhaustible and nonreproducible resource. Competent authorities have estimated that with increased drilling activity within continental U. S. more petroleum reserves will be available; these will push farther back the date of ultimate exhaustion of this country's petroleum reserves. Long before that date, however, these same competent authorities indicate that technological processes will have been developed to render economically available the hydrocarbons present in natural gas, oil shale, asphalt sands, coal, and in other forms. Compared with total past petroleum production and future petroleum reserves in this country, hydrocarbons from natural gas more than equal such oil reserves, from oil shale they exceed four times, and from coal they exceed 60 times this tremendous amount.

Tests Started in 1935

Technical research, stimulated by the war, has accelerated the tempo of prewar research on the conversion of these various natural resources into usable hydrocarbons. Principal among these has been the development of the Synthol process for manufacturing liquid hydrocarbons and other products from natural gas. The following data are pertinent to a consideration of this process:

1. Since 1935, the M. W. Kellogg Co. has conducted research on this process. In 1937, data on the Fischer-Tropsch process were obtained by Kellogg. During the intervening years, Kellogg has pioneered the development of this work into commercial plant design.

2. As an answer to the wartime cries of "shortage of oil," this Synthol process will produce motor gasoline (75 "clear" octane CFR-M) for approximately 5c per gal. (including 10% depreciation) from natural gas valued at 5c per 1000 cu. ft.

3. Besides gasoline as outlined above, this Synthol process produces other liquid hydrocarbons, e. g., Diesel oil (90-100 Diesel index) and butane and, under controlled conditions, various chemical products in the form of oxygenated compounds. Changing the operating conditions will control the quantity and quality of the production of the hydrocarbons and of the chemical compounds.

4. Chart I (*See p. 38*) presents a simplified flow-diagram of the Synthol process.

It involves the following steps:

A. Purification—removal of sulfur and

Easy-pouring containers.....Plastic lures that gleam
Fiber drums to keep things dry.....And cans in a steady stream
ARE ALL MADE BY CONTINENTAL CAN COMPANY
Did you know that Continental is the 2nd largest producer of crown caps? Has complete and up-to-date facilities for fabricating plastics? Makes a full line of paper and fiber containers?
Why, then, do we still call ourselves the Continental Can Company? Well, we're pretty proud of that name. Thousands of businessmen have learned to rely on it for products and service of the highest quality.
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OPERATING DIVISIONS: The Container Co. Van Wert, Ohio · Keystone Drum Company, Pittsburgh, Pa. · Boothby Fibre Can Division, Roxbury, Mass. · Mono Containers, Newark, N. J. — Plastics Division, Cambridge, Ohio. Bond Crown & Cork Co., Wilmington, Del. Cameron Can Machinery Co., Chicago, Ill.
FOREIGN SUBSIDIARIES: Continental Can Company of Canada, Limited, Sun Life Building, Montreal, Canada · Sociedad Industrial de Cuba, S. A., Havana, Cuba.
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Tune in "REPORT TO THE NATION," every Saturday over CBS coast-to-coast network.

THIS IS ANOTHER in Continental's new advertising series. It tells folks we're still mighty active in our regular business of making cans—by the carload! But this colorful campaign goes on to tell how we've expanded our facilities to bring you complete service. And we're making a startling variety of things of all kinds at Continental right now. So keep an eye open for these striking full-color ads in America's leading national magazines—Time, Newsweek, U. S. News, Business Week and Fortune. Keep an eye on Continental—and on Continental's trademark too! The Triple-C stands for *one* company with *one* policy—to give you only the very best in quality and service.

other deleterious compounds.

B. Synthesis gas preparation—conversion of the natural gas to carbon monoxide and hydrogen.

C. Synthesis reaction—in the presence of the selected catalyst, under controlled conditions, conversion of the gas to the desired hydrocarbons and the desired chemical compounds.

D. Condensers—condensation of the various products to liquid form.

E. Gas separator—separation of the oil layer containing the liquid hydrocarbons from the water layer containing the chemical compounds, and separating and recovering the light gaseous products.

F. Stabilization and fractionation of the various liquid hydrocarbon products into gasoline and Diesel oil.

G. The liquid chemical compounds are separated and recovered.

Rapid Financial Return

5. A complete Synthol plant to produce a large volume of liquid hydrocarbons, it is presently estimated, would have a "pay-out-time" of approximately eight years. A combined Synthol and chemical plant, it is presently estimated, would have a "pay-out-time" of approximately three years. This acceleration in financial return is due to increased values of the chemical compounds over the values of the hydrocarbons.

6. In all these calculations the cost of 5c per gal. of gasoline from the Synthol process includes no value for chemical compounds and is independent of the investment and profit from the operation of the chemical plant.

7. Kellogg's analysis of Synthol economics seems to indicate:

A. The plant should be located close to large gas reserves. Approximately 11,000 cu. ft. of natural gas are required to produce one barrel of liquid hydrocarbon product. Foreseeable gas reserves should at least equal 10 years' plant requirements.

B. The plant should be located on water to achieve lowest cost transportation for both kinds of products—hydrocarbons and chemical compounds. Location on the Gulf Coast, providing water transportation to the industries of the East Coast and to the upper Mississippi Valley, would be quite advantageous.

C. Undoubtedly, postwar conservation regulations of the Texas Railroad Commission, and of other states, will enforce "gas-oil-ratios." Continued satisfactory operation of a Synthol plant, requiring large volumes of natural gas, would necessitate the location of the Synthol plant contiguous to a presently operating or newly built oil refinery to handle the large quantities of oil produced under these "gas-oil-ratios."

D. The plant should be operated in conjunction with a petroleum refinery to assure constant availability of skilled technical personnel for general supervision, and for joint utilization of existing refining and distributing facilities.

E. Present research indicates that operating costs for the separation and the recovery of the chemical compounds are low, regardless of the assumed initial value, for accounting purposes, of the by-product "stream" from the manufacture of the liquid hydrocarbons, which, in turn, becomes the raw material for the recovery of the chemical compounds.

F. While the total volume of oxygenated compounds produced from any one plant constitutes a small percentage of the total prewar, and estimated postwar, consumption of similar products by the chemical industry, the operation of many such plants by the petroleum industry might saturate the market for such chemical compounds and would adversely affect the profitability of such plants.

Evaluated under present economic circumstances, the factors of investment, of gas reserves, of cheap transportation, of marketing considerations, and of understanding of chemical industries, will create limitations which will undoubtedly serve to caution the wide-spread participation by many oil companies.

The Synthol process can have unusual economic advantages for petroleum companies qualified to use it effectively.

Links Oil, Chemical Industries

Kellogg's Synthol process is another milestone in the inevitable union of some of the interests of the petroleum industry with some of the interests of the chemical industry. This Synthol process not only assures the economic availability of large volumes of gasoline and Diesel fuel, so essential for the industrial and social standard of living in this country, but it also provides means for the mutual intelligent and profitable development of the petroleum industry's resources with the successfully functioning facilities of the chemical industry.

Petroleum companies now occasionally consider whether they "will enter the chemical industry." As Dr. Robert E. Wilson, chairman of the board, Standard Oil Co. of Indiana, recently indicated, the petroleum industry is already deeply in the chemical business.

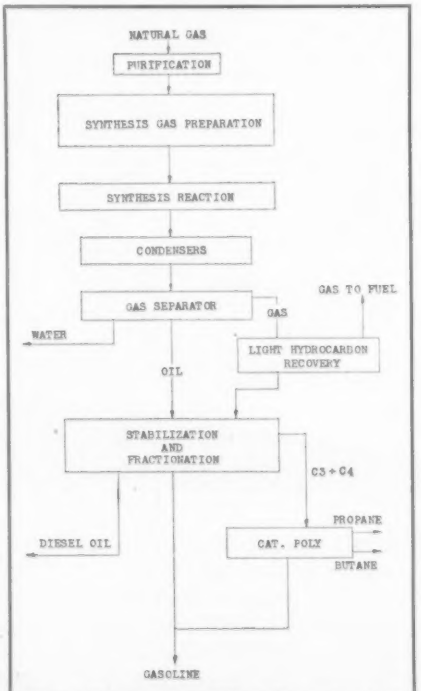

Chart No. 1—Simplified flow chart of the Synthol process

Wartime production of toluene is over five times the prewar total combined production of phenol, aniline, and toluene, all used as synthetic organic chemical compounds. Dr. Wilson further pointed out that the wartime production of butadiene is over 27 times the prewar production of phenol, and the petroleum industry's production of ethyl alcohol, also used in the production of synthetic rubber, is almost twice the total prewar consumption of ethyl alcohol for all purposes. And over half of our 100-octane aviation gasoline is made from the newly developed chemical engineering union of two hydrocarbons by the petroleum industry. The petroleum industry is very definitely in the chemical industry.

The petroleum industry fundamentally makes and distributes products which are manufactured on a mass-scale, which have broad specifications and universal use, which have high rates of consumption, which are sold through hundreds of thousands of retail outlets on narrow margins at a low price to consumers who have no facilities for storage and are "high-frequency" repeat customers.

The chemical industry on the other hand has, up to now (excepting some few products in broad mass consumption), made comparatively small volumes of individual products which conformed to rigid specifications for particular and limited uses, which were sold at long margins of profit and at high prices to comparatively few customers who contracted for purchase infrequently and who had adequate facilities for storage.

Besides, financial comparisons show that the chemical industry does 80% of the dollar business of the petroleum industry and makes 125% of petroleum's net income. Operating profits of chemical industry's larger companies annually average over 30% and net income averages 20%; the petroleum industry's larger companies are fortunate to fare half as well. Wartime chemical volume is over four times prewar; the desire by normally "marginal" companies in the chemical industry to perpetuate their postwar economic existence will further intensify postwar competition in the chemical industry.

On almost every characteristic of the distribution and marketing of their products, the petroleum and the chemical industries have been markedly dissimilar. This dissimilarity urges the petroleum industry to give serious consideration to those successful and profitable techniques of marketing chemical products which have been so long established by the chemical industry. Any destructive competition between the two gigantic industries would undoubtedly produce unfortunate repercussions for all concerned. Historic long margins and high profits on chemical products would offer chemical companies unusual leverage in successfully coping with postwar competition. particularly in the marketing of those broadly available chemical compounds unprotected by sound patent positions.

Study the new 100% Pure Pennsylvania Motor Oil Advertising ...geared to the present and future.

Its message is important in today's situation ... and vital to coming post-war days.

YES! 100% Pure Pennsylvania oils are *Balanced*. That means they rate tops in all characteristics by which motor oils are judged . . . *every* lubrication point, not just one or two. Color pages in national magazines are telling the "balance" story straight through the year.

The motoring public knows and respects emblem oils. In war or peace, consumer demand for these quality oils is steady.

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For your protection, oils made from 100% Pure Pennsylvania Crade Crude which meet our rigid quality requirements are entitled to carry this emblem, the registered badge of source, quality and membership in our Association.

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H. F. King Heads Oil Scouts

Special to NPN

DALLAS—New president of the National Oil Scouts and Landmen's Assn. is H. F. King of the Continental Oil Co., Ardmore, Okla., who was elected at a meeting of delegates here.

Mr. King succeeds J. L. Johns of the Freeport Sulphur Co., New Orleans, who was named chairman of the board of directors.

Other officers elected included: F. D. Johnson, Superior Oil Co., Corpus Christi, first vice-president; Hal Walker, Ohio Oil Co., Casper, Wyo., second vice-president; and J. M. Knoepfel, Atlantic Refining Co., Carlsbad, N. M., secretary-treasurer.

W. G. Sinclair of the Gulf Oil Corp., Wichita Falls, was chosen editor of the Association's year book.

G. L. Tatum Withdraws From Firm

Special to NPN

SHREVEPORT, La.—G. L. Tatum has withdrawn from the firm of Tatum, Dunbar & Shaddock, oil operators, and will operate individually in Texas, Louisiana and Mississippi. His headquarters will be in Corsicana, Tex.

D. G. Dunbar and R. L. Shaddock will operate, as formerly, in the same three states. Mr. Dunbar's headquarters will be in Corsicana, and Mr. Shaddock will remain in Shreveport.

Pacific Coast A.P.I. Leaders Hear Boyd's Plea For Fair Reward for Nation's Oil Industry

NPN News Bureau

LOS ANGELES — If the United States and the rest of the world are to reap the full benefits of petroleum, the way must be cleared and kept cleared for individual enterprise, achievement and reward, and then kept open for production, processing, transport and distribution of oil and petroleum products.

That was the declaration last week of William R. Boyd, Jr., president of the American Petroleum Institute and chairman of the Petroleum Industry War Council, who was one of the speakers at the wartime conference of the Pacific Coast District, Division of Production, of the A.P.I.

"If the world wants petroleum, artificial barriers must not be erected by governments to keep men from seeking it wherever it may be found, and from profiting from their discoveries," Mr. Boyd said.

Davies Urges Oil Pact

The speaker reviewed the vital part the petroleum industry has played in building the war machine. He termed hydrocarbon chemistry "an achievement outstanding in modern science, the seeds from which most new postwar industries will spring."

Deputy PAW Davies declared that if the world is to have a lasting peace, an international oil agreement is vitally necessary.

"The idea of an international oil agreement springs from a recognition of the fact that in the modern world oil is as indispensable in peace as it is in war," Mr. Davies said, and added:

"Depending upon how the world reserves of this basic commodity are managed, it will either enhance our chances for future peace in the world or it will endanger that prospect. Oil, as you know, has in the past both contributed to the maintenance of peace and to the advent of war. As liquid power and black gold its potentialities are great for good or evil, beyond that of any other commodity. More than once oil has figured prominently in international relations."

Mr. Davies commended California's phenomenal record in producing petroleum, and pointed out the unprecedented quota asked for April.

"California is asked to produce this coming month 918,800 bbls. of crude per day, 58,560 bbls of casinghead and condensate; a total of 977,360 bbls. of petroleum liquids. This is indeed an enormous production and represents an increase of almost 44% over the prewar level for the fields of this state," the deputy PAW said.

Mr. Davies disclosed that the world-wide requirement of the United Nations today exceeds 7,000,000 bbls. of oil per day. Of this, he said, the United States is called upon for 5,150,000 bbls. or 69%; South America 14%; the countries of the Middle East 7%, and Russia 9%. He didn't say who supplied the other 1%.

Cites Drain on Reserves

Ralph J. Schilthuis, assistant director of the production division of PAW, said that if the United States wished to preserve its oil reserves it must find ways and means of discovering and opening new fields.

He backed up his argument for the development of new reserves by citing the tremendous drain on the nation's reserves caused by the war.

Mr. Schilthuis said that American production had been increased 1,000,000 b/d over the prewar figure of 3,800,000 b/d, but of this stepped up production only 40% had come from new fields, thus draining established reserves.

"California, which in 1941 was producing 650,000 b/d, has boosted its wartime output to 915,000, which is above the average national increase," the PAW official disclosed.

Others Who Read Papers

Papers presented at the all-day meeting, which drew approximately 1,000 oil men, included the following:

"Gas Lift Through Small Tubing," by A. C. Tutschulte, Tide Water Associated Oil Co., Los Angeles; "California's New World-Record Hole," by Omar A. Cavins, Standard of California, Taft; "Field Testing of Drilling Fluids," by Vernon B. Zacher, Tide Water Associated Oil Co., Ventura; "Oil Well Casing Failures," by F. R. Schmieder and R. J. Kettenburg, Shell Oil Co., Ventura; "Reservoir Fluid Research," by Norris Johnston, General Petroleum Corp., and N. Van Wingen, Richfield Oil Corp., Los Angeles; "Performance of Multi-Zone Wells in the Wilmington Field," by Read Winterburn, Union Pacific Railway Co. and Carlton Beal, Richfield Oil Corp., Los Angeles.

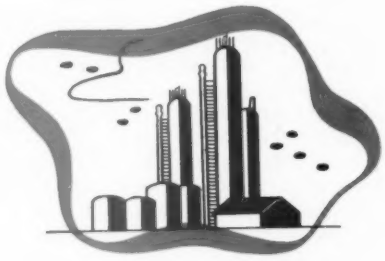
'They Never Failed Us'—A Young Officer Speaks

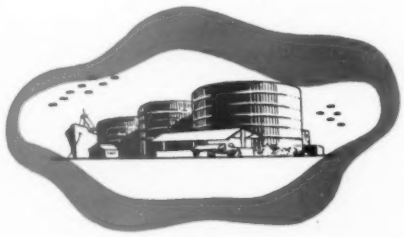
NPN News Bureau

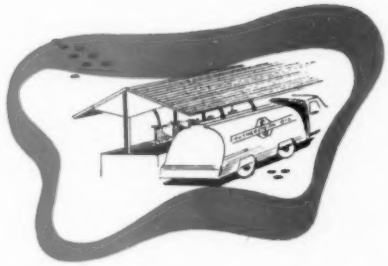
LOS ANGELES—Here is a true story of oil-at-war in which all oil men can take pride. It was told by Deputy PAW Davies at the A.P.I. Division of Production meeting last week in Los Angeles. Recalling a conversation with a young naval lieutenant just back from the Pacific, Mr. Davies said the officer told him about a push toward Island "X" in a task of great importance.

"Frankly, I was getting pretty worried," Mr. Davies quoted the officer as saying. "So were a lot of my shipmates. We didn't like the prospect of running out of fuel in that place where anytime the Japs might be along—with us squatting there like a sitting duck. The skipper didn't seem bothered so much, but he never seemed bothered about anything.

"Then one morning just before dawn I looked out through the mist and there was the most beautiful sight I think I ever saw—a big gray Navy tanker. What a relief! But you know it's a funny thing; later we got so we just took this for granted. Whenever we had been burning a lot of oil or when our planes had been active and using a lot of gasoline, we'd look off port or starboard some morning at dawn and sure enough, there crawling through the mist, would be one of those faithful old Navy tankers. They never failed us."







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Our plans call for modern ocean terminals at all important deep water ports along the Atlantic seaboard from Miami, Florida to Boston, Massachusetts, and Tampa, Florida in the Gulf. These facilities will be conveniently located for the distribution of all principal grades of petroleum, including aviation gasoline and asphalt, to independent petroleum marketers.

Pipeline terminal facilities are planned for those areas which are more economically served by such transportation.

You who plan now to depend on Southeastern will find that our facilities, products, competitive transportation (including large fast tankers) and distribution make us your complete supplier.

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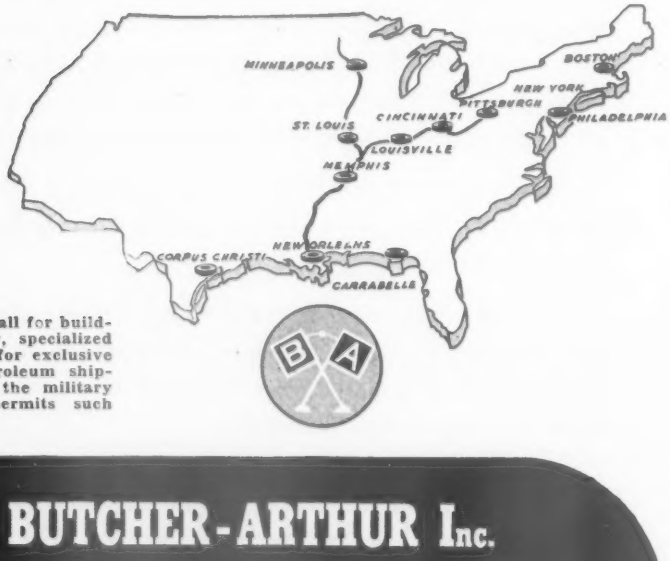
Through Service for CRUDE OIL and PETROLEUM PRODUCTS

As a company specializing in the waterway movement of crude oil and petroleum products, we are working at capacity right now, moving 125 million ton miles a month of these vital war products. We offer through service from the Texas-Louisiana Gulf Coast to Carrabelle, Florida, and via New Orleans up the Mississippi and Ohio Rivers to Mid-West and Eastern terminals in more than 250 cities.



Our plans call for building of new, specialized equipment for exclusive use of petroleum shippers, after the military situation permits such expansion.

BUTCHER-ARTHUR Inc.
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Texans in Compromise On Gas Saving Bill

Special to NPN

AUSTIN — Enactment of major legislation governing the production of natural gas advanced a step nearer reality when representatives of the industry and members of the Texas Railroad Commission agreed on a compromise substitute measure.

The points agreed upon will be written into a bill which will be introduced in the Legislature as a substitute for several bills now pending.

Chairman Olin Culberson of the Commission hailed the agreement as a step toward solving the problem of flare gas. "It is a compromise and doesn't meet everyone's wishes," he said, "but it is a great step forward."

List Points of Agreement

In brief, the major points agreed upon are:

1. The oil companies will be under obligation to deliver to the natural gas pipelines all casinghead gas reasonably close to the lines. The gas shall be in marketable form, free of most sulfur, and the pipelines will take it at local prices. The Commission is empowered to decide what is a "reasonable" distance from a pipeline.

2. The gas producers agreed to support a provision for pressure maintenance in gas fields, where such can be done without confiscation of property and where the yield of liquid hydrocarbons is at least one and one-half gallons per 1000 cubic feet of gas.

3. The bill clarifies definitions of oil and gas wells and sour gas, and limits the withdrawal of gas with oil to 2000 cubic feet per barrel of oil, a present limit from which there are various exceptions. Gas-lift wells may use 5000 cubic feet per barrel instead of the present 10,000.

4. The Railroad Commission would have the authority to prorate the market demand for gas from wells in a common reservoir.

The entire revision of the gas statutes would not become effective until next March, in order for the companies involved to make the necessary conversions.

Warns of U. S. Intervention

Proponents of the measure said they would offer the drafted bill at a meeting of the House committee on oil and gas April 5.

Dozens of industry representatives took part in the discussions with Commissioners Culberson and Beauford Jester (Commissioner Ernest Thompson is in Washington on a tour of duty with the Army).

Marshall Newcomb of Dallas, general attorney for the Lone Star Gas Co., agreed that the measure represents a compromise of views among all parties concerned.

It is estimated that up to a billion cubic feet of natural gas daily are being

flared in connection with oil production. On the eve of the five-day conference with the industry men, Commissioner Culberson issued a public statement warning that unless some steps toward conservation are made, intervention by the federal government seems assured.

"I think the Federal Power Commission is headed that way in a hurry right now," he said.

Bill Bars Seismograph Crews From Boring Rights-of-Way

Special to NPN

AUSTIN — Provoking an argument on "who's robbing who", the Texas House of Representatives Highway Committee has reported favorably a bill which would make it unlawful for geophysical crews to use highway rights-of-way for seismograph and other geophysical research. The vote was 5 to 4.

Rep. Mainor Westbrook of Magnolia Springs, who wrote the bill, explained that geophysical companies, when denied access to private property, often made their borings and set off their charges on highway rights-of-way adjacent to the property.

By this means, he said, they could make preliminary determination of the prospects of finding oil on the property in question.

Rep. L. R. Pearson of Ranger argued that such a law would make it possible for land-owners to "hold up" oil companies, but this was countered by Rep. Cecil H. Barnes of San Angelo who said that landowners usually are willing to take a reasonable fee from exploration units.

Graburg Loses Lease Fight

AUSTIN — The Graburg Oil Co. has lost its move to force the state land office to renew its lease on 280 acres of Pecos River bed in Pecos and Crockett counties.

The Texas Supreme Court overruled the motion of the company, which contended that a law passed in 1925 which excused the payment of rental on "bays, marshes, reefs, salt water lakes, or other submerged lands" where there has been certain production.

The Court held that "other submerged lands" does not apply to river beds. State Land Commissioner Bascomb Giles had refused the extension of the lease on the grounds that the rental had not been paid.

New Gas Well in Rio Vista

Special to NPN

SAN FRANCISCO — Completion of its second natural gas well in the Rio Vista field was announced last week by Natural Gas Corp. of California, a subsidiary of Pacific Public Service Co.

The well, No. H-3, was drilled to a depth of 5,440 ft. to tap the Margaret Hamilton sand, which lies next below the main producing zone. On a test the well flowed at the rate of 12,800,000 cubic ft. of gas a day.

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Long respected for the quality it represents, the familiar trade-mark of the Milwaukee Valve Company today stands as an emblem of endurance and efficiency—a mark of merit that signifies the very best in valves and fittings for oil industry.

This trade-mark represents many years of practical experience in the manufacture of precision valves which has resulted in many new and important improvements in valve design and construction. The operating efficiency, strength and life of Milvaco products has thereby been increased which assures peak performance and economy in service under the most rugged conditions.

The ready acceptance of Milvaco valves by the Army and Navy is a fitting tribute to their unfailing dependability.

And because the demands of war have stepped up the tempo of our production processes, we are now able to keep pace with our war contracts and still provide a substantial volume for domestic needs—thus permitting us to take care of your more urgent requirements.

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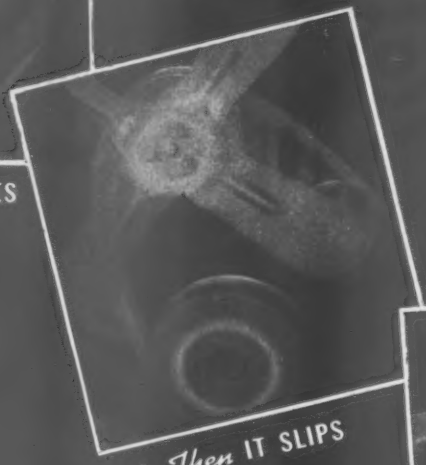
THE LIFE STORY OF A FAN BELT

1. *First* IT STRETCHES



2. *Then* IT SLIPS

3. *Then* IT WEARS

4. *Then* IT FAILS

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Get the greater sales and greater profits made possible by the Thermoid Fan Belt Program and the Thermoid Sales Reward Premium Plan. Ask your jobber, or write to THERMOID COMPANY, TRENTON, NEW JERSEY.

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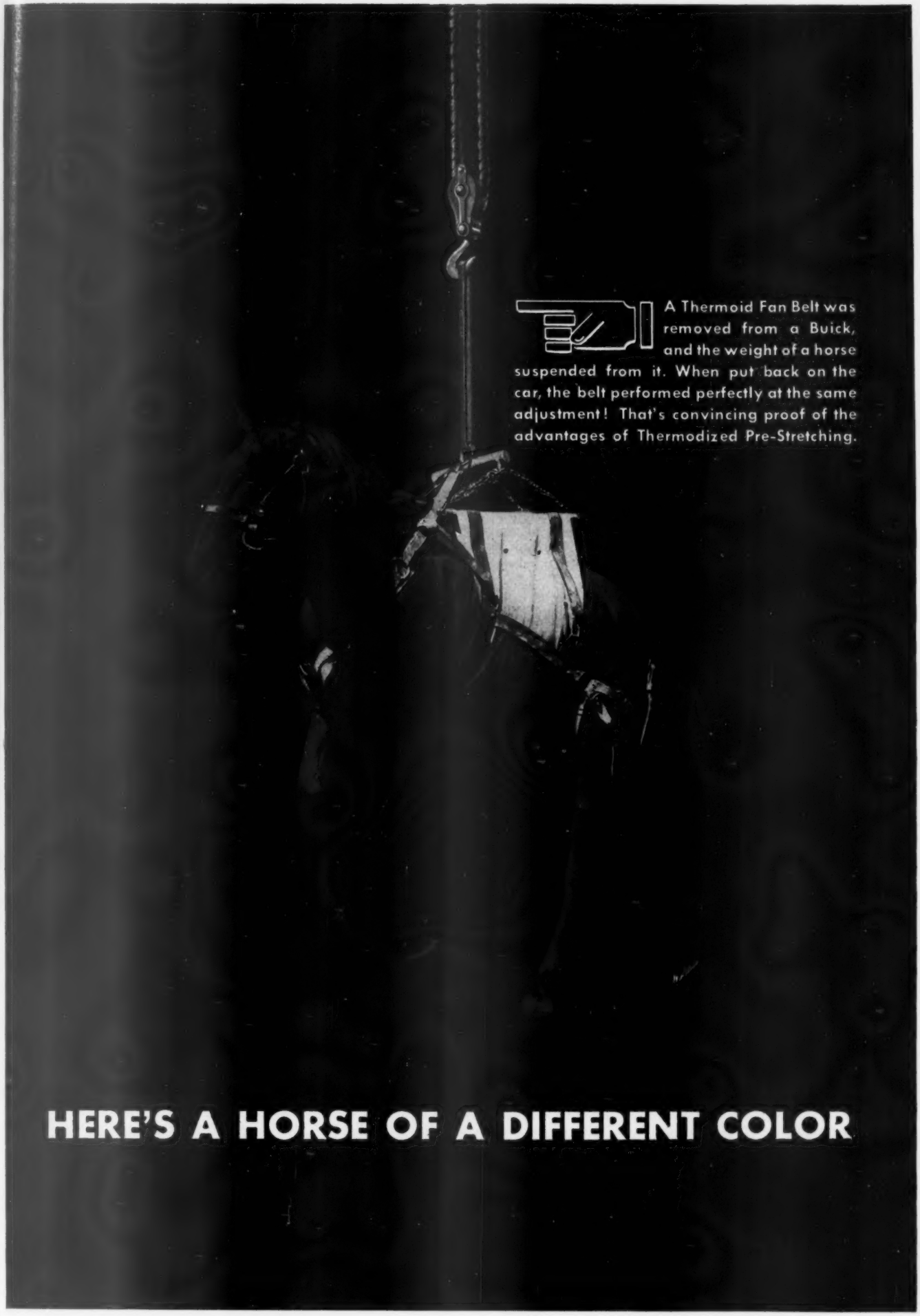
A Thermoid Fan Belt was removed from a Buick, and the weight of a horse suspended from it. When put back on the car, the belt performed perfectly at the same adjustment! That's convincing proof of the advantages of Thermodized Pre-Stretching.
HERE'S A HORSE OF A DIFFERENT COLOR

Reports from 46 Selected Operators Show 618 Bulk Plants, 17,363 Retail Outlets Closed in Dist. 2 as of Jan. 1

CHICAGO—Rationing and other war restrictions resulted in the net closing of 618 bulk plants and 17,363 retail outlets in Dist. 2 between Jan. 1, 1942 and Jan. 1, 1945, according to a statement compiled by the Dist. 2 D. & M. committee from reports made by 46 selected operators.

Total bulk plants in operation Jan. 1, 1942, was 11,102, which number less 618 closed three years later, left 10,484 still open. Retail outlet figure for similar dates was 81,659, less 17,363 closed, left 64,296 open as of last Jan. 1.

This is a net loss of 5.6% of the bulk plants and 21.1% of the retail outlets, as shown by the D. & M. Committee statement. However, it was explained that the figures include 164 bulk plants and 244 retail outlets operated by Standard Oil Co. of Nebraska until Dec. 1, 1944, when Standard of Indiana absorbed that subsidiary.

This largely explains the net increase of 137 bulk plants and 689 retail outlets closed during the last half of 1944, as shown in the D. & M. statement, which follows:

Statement of the Number of Bulk Stations and Retail Outlets Closed in District 2

AS REPORTED BY 46 SELECTED OPERATORS

Net Number of Bulk Stations:	Ill.	Ind.	Iowa	Kan.	Ky.	Mich.	Minn.	Mo.	Nebr.	N. D.	Ohio	Okla.	S. D.	Tenn.	Wis.	Total
Operated January 1, 1942	1,480	950	1,256	1,065	293	864	1,008	872	218	515	709	555	371	158	788	11,102
Closed During 1942	57	18	40	122	8	23	23	41	16	8	26	57	8	+1	0	446
Closed During 1943	+10	14	43	63	0	33	18	29	+30	27	5	5	17	1	13	228
Closed During 1st Half 1944	5	8	20	+10	+2	1	17	1	12	3	11	8	12	0	+5	81
Closed During 2nd Half 1944	10	...	4	+4	1	+5	9	2	+164*	2	3	2	7	+2	+2	+137
Total Closed to January 1, 1945	62	40	107	171	7	52	67	73	+166	40	45	72	44	+2	6	618
Net Number of Retail Outlets:																
Operated January 1, 1942	10,983	7,565	4,826	2,894	6,670	8,243	4,864	6,612	959	1,158	13,306	3,472	1,055	3,518	5,534	81,659
Closed During 1942	1,809	941	890	806	654	1,528	792	1,103	157	185	2,053	765	164	512	559	12,918
Closed During 1943	623	501	243	137	573	410	394	553	14	63	761	207	58	125	437	5,099
Closed During 1st Half 1944	+31	14	79	45	65	+157	+5	21	+5	130	+143	161	61	+34	+166	35
Closed During 2nd Half 1944	+49	+84	+30	+19	+19	17	+61	41	+244*	+1	+58	+61	+5	7	+123	+689
Total Closed to January 1, 1945	2,352	1,372	1,182	969	1,273	1,798	1,120	1,718	+78	377	2,613	1,072	278	610	707	17,363

* Increase due to Standard Oil Company of Indiana assuming operations of Standard Oil Company of Nebraska as of December 1, 1944.

Statement of the Percentage of Bulk Stations And Retail Outlets Closed in District 2

AS REPORTED BY 46 SELECTED OPERATORS

Net Number of Bulk Stations:	Ill.	Ind.	Iowa	Kans.	Ky.	Mich.	Minn.	Mo.	Nebr.	N. D.	Ohio	Okla.	S. D.	Tenn.	Wis.	Total
Operated January 1, 1942	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
Closed During 1942	3.9	1.9	3.2	11.5	2.7	2.6	2.3	4.7	7.3	1.6	3.7	10.3	2.2	+.6	.0	4.0
Closed During 1943	+.7	1.5	3.4	5.9	.0	3.9	1.8	3.3	+13.7	5.2	.7	.9	4.5	.6	1.7	2.1
Closed During 1st Half 1944	.3	.8	1.6	+.9	+.7	.1	1.7	.1	5.5	.6	1.6	1.4	3.2	.0	+.6	.7
Closed During 2nd Half 1944	.7	...	.3	+.4	.4	+.6	.8	.3	+75.2	.4	.4	.4	1.9	+1.3	+.3	+1.2
Total Closed to January 1, 1945	4.2	4.2	8.5	16.1	2.4	6.0	6.6	8.4	+76.1	7.8	6.4	13.0	11.8	+1.3	.8	5.6
Net Number of Retail Outlets:																
Operated January 1, 1942	100 0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
Closed During 1942	16.5	12.4	18.4	27.9	9.8	18.5	16.3	16.7	16.4	16.0	15.5	22.0	15.6	14.5	10.1	15.8
Closed During 1943	5.6	6.6	5.1	4.7	8.6	5.0	8.1	8.4	1.4	5.4	5.7	6.0	5.5	3.6	7.9	6.2
Closed During 1st Half 1944	+.3	.2	1.6	1.5	1.0	+1.9	+.1	.3	+.5	11.2	+1.1	4.6	5.8	+1.0	+3.0	.0
Closed During 2nd Half 1944	+.4	+1.1	+.6	+.6	+.3	.2	+1.3	.6	+25.4	+.1	+.4	+1.7	+.5	.2	+2.2	+.8
Total Closed to January 1, 1945	21.4	18.1	24.5	33.5	19.1	21.8	23.0	26.0	+8.1	32.5	19.7	30.9	26.4	17.3	12.8	21.2

Battery Assn. Head Warns Against Use of 'Dopes'

CLEVELAND — On the heels of a critical battery situation that may force many vehicles out of service within the next few months, the "doping" racket is sweeping the country.

This warning was sounded by E. T. Foote, president of the American Assn. of Battery Manufacturers. He said that racketeers, taking advantage of the situation are "preying on the car owner and battery dealer, selling them flour, sand, epsom salts, or just any old white powder as the panacea for all battery troubles".

The racket has assumed such proportions in recent months, Mr. Foote said, that the U. S. Department of Commerce, Bureau of Standards and the National Better Business Bureau of New York City have issued bulletins in which the evil is thoroughly exposed.

In further cautioning car owners against the use of battery "dopes" in any form, Mr. Foote pointed out that most battery manufacturers void the guarantee of their batteries if other than pure water or approved battery electrolyte is added.

"The battery machinery is doing everything possible to impress upon car owners the urgent necessity of having their batteries properly cared for," Mr. Foote said, "but in the final analysis the responsibility rests with the individual car owner. He can prevent the inconvenience to himself and the loss of his car as a unit of the country's wartime transportation facilities by doing three things. First, make sure that his battery is serviced by a reliable battery service station. Second, have his battery checked immediately and third, have it checked regularly."

Lifetime Ration Is Prize for Naming 'Gas' for Ohio Oil

NPN News Bureau

CLEVELAND — The Ohio Oil Co. has announced a contest in which the grand prize will be sufficient gasoline to drive 10,000 miles a year for the life of the winner. In addition, the winner who gives the best name for the company's postwar gasoline, will receive free all the gasoline his coupons allow during rationing. War bonds in denominations of $500 to $25 will be given "runners-up".

In addition to the consumer prizes, war bonds are to be awarded to dealers whose customers win prizes. The dealer whose customer wins first prize will receive a $100 war bond, the second a $50 war bond, and each dealer whose customer wins one of the other prizes will receive a $25 war bond.

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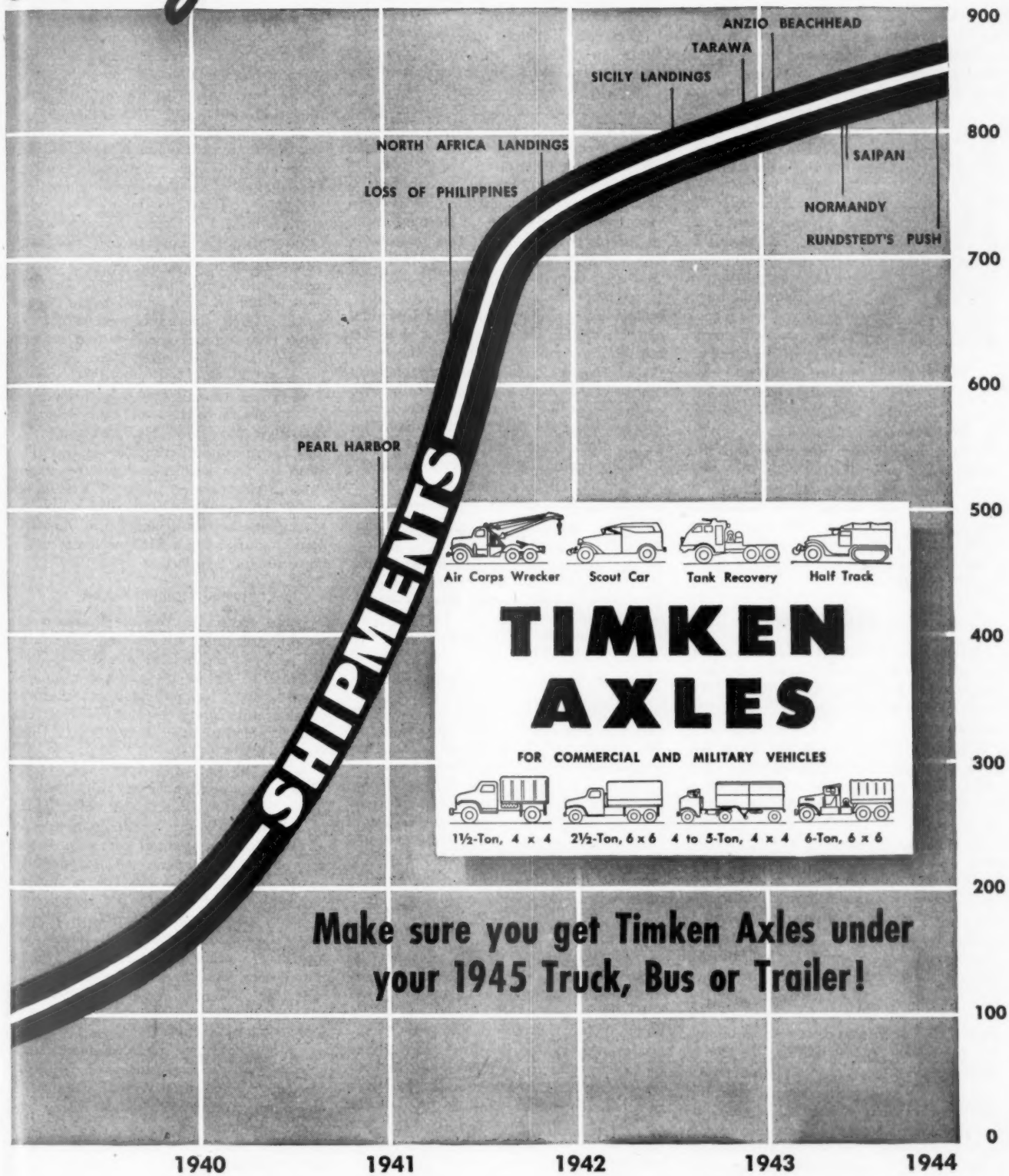

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The Timken-Detroit Axle Co., Detroit 32, Michigan. **Wisconsin Axle Division, Oshkosh, Wisconsin.**

Beginning Discussion of Wage-Hour Law As It Applies to Oil Burner Dealer's Business

By Elwin E. Hadlick

It has been suggested that the necessary amount of space be devoted to consideration of the wages and hours law as it affects the oil burner sales, installation and repair business. Much of what has already been said about this law is applicable to the particular industry to which attention is now directed.

Mr. Hadlick

Nevertheless, it has been requested that the articles relating to the application of the law to oil burners have a separate and complete entity; that will be the purpose of this and of as many succeeding articles as are necessary reasonably to cover the ground.

These articles will not deal with the problems of manufacturers of oil burners. They will consider problems of dealers who sell, install or service burners. Where there is a difference in the application of the rules, it will be made clear which phase of the business is being discussed.

Employs Widest Application

What basis is there for believing that the wages and hours law applies to dealers engaged in selling, installing, or servicing oil burners under any circumstances.

Coverage by the wages and hours law is on the basis of what the employe does rather than on what the employer does; in other words, an employer may well be covered by the law in connection with some of his employes but not covered as to others. It is a matter of necessity that consideration be given in broad terms first to the industry in which the particular dealer is engaged.

The law relates to employes engaged "in interstate commerce" or "in the production of goods for interstate commerce". It is neither necessary nor desirable to reconsider the methods by which the Administrator has made up his mind what is covered by the use of words of that kind in the law.

It can be said rather simply that the Administrator has made an attempt to bring within the law everyone who has anything at all to do with interstate commerce or in the production of goods for interstate commerce, in the broadest sense in which those words can be used. The Administrator has said "Congress intended the widest possible application of its regulatory power over interstate commerce."

One gets a feeling that he is not entirely sure of the meaning of things when he tries to apply the words of the Administrator's Interpretative Bulletins to those phases of the oil burner business which we are here considering. There is nothing specific about oil burners in those bulletins.

There is a paragraph in Bulletin 5 which carries the heading "local construction contractors". Burner men might be led to reading this paragraph, and there is some basis for believing that the Administrator might say that it applied.

The paragraph reads: "The question arises whether the employes of builders and contractors are entitled to the benefits of the act. The employes of local construction contractors generally are not engaged in interstate commerce and do not produce any goods which are shipped or sold across state lines. Thus, it is our opinion that employes engaged in the original construction of buildings are not generally within the scope of the act, even if the buildings when completed will be used to produce goods for commerce. There may be particular employes of such construction contractors, however, who engage in the interstate transportation of materials or other forms of interstate commerce and are for that reason entitled to the benefits of the act."

Elwin E. Hadlick, prominent oil marketing executive and attorney, begins in the accompanying article a discussion of the Wages and Hours Law as it applies to the oil burner sales, installation and repair business. It is the 55th in his series on war-oil regulations and compliance.

Careful Reading Necessary

Most oil burner dealers and service men would approach consideration of the question of possible coverage by the act with a feeling that there was likely no intent on the part of Congress to include them under the law; they might be led by that quoted paragraph to believe that they were exempt, and yet they would wonder, because they would realize that the vast majority of their work is not in connection with construction of new buildings.

Upon reaching the conclusion that the quoted paragraph would not give them a complete release from the law, oil burner dealers, installers, and repairers would read the next paragraph of the Interpretative Bulletin, which bears the heading "interstate construction contractors".

In that paragraph the Administrator says: "Employes of contractors engaged in maintaining, repairing or reconstructing * * * essential instrumentalities of interstate or foreign commerce would seem to be engaged in interstate commerce and subject to the act; and employes of contractors who are employed in maintaining, repairing or reconstructing buildings or machinery used to produce goods for commerce would seem to be engaged in a 'process or occupation necessary to the production' of such goods within * * * the act and, therefore, within the coverage of the act."

At about that point, the oil burner man would begin to feel differently than he had before, and would begin to get an idea that his operations might be covered in some respects, or that at least he was near the border line and that he ought to find out where he stands.

At about this time it might occur or be suggested to the oil burner dealer that there have probably been some rulings specifically relating to his business. With that kind of a thought, he might consult any one or more of the books which are prepared and sold with the idea that they will assist the business man in determining his problems under Government regulations.

Special Opinion Given

Quite naturally, the oil burner man would look under the heading "Oil Burners". If he did so, he would find that, at least so far as the indexes are concerned, there has not been the slightest consideration given to his problem. It would not be safe, however, to stop there.

It can be determined that in March, 1941, in an opinion letter, the Administrator stated that while the installation of heating systems would not appear to be within the general coverage of the act, unless such operations are properly to be considered as incident to an interstate contract of sale, the installation of such systems in industrial buildings which are used to produce goods for interstate commerce would fall within the general coverage of the act.

It can also be determined that in May of 1942 the Administrator issued a special opinion that the exemption for retail and service establishments may be applicable to employes engaged in installing oil heating and air conditioning outfits in private homes. He said that installation and service employes may be considered engaged in interstate commerce or in production of goods for interstate commerce and yet be exempt under the exemption provisions, if engaged in a bona fide retail

or service establishment which does the greater part of its selling or servicing in intrastate commerce.

Rulings of that kind immediately suggest taking a look at the exemptions which may be provided by the law. Those exemptions will be considered next week. It will develop that some oil burner dealers have some employes who are covered by the wages and hours law; it is the purpose of these articles to determine who those employes are and the manner in which they can be detected.

Index of Week's War-Oil Orders

(March 24-31, 1945)

OPA—Office of Price Administration

GMPR, Order 50 under §1499.19a—Ceilings on rubber grades of non-specialty furnace carbon black produced from propane.

RSR 1, Am. 96—Exceptions to RSR 1's jurisdiction.

RSR 11, Am. 57—Certain machinery services excepted from RSR 11's coverage.

RPS 49, Am. 30—Trucking costs may be added to price of excess oil country tubular goods.

RMPR 436, Am. 12—Stripper well premium payment plan increases removed from RMPR 436 to a separate regulation.

MPR 581—Ceilings on industrial services.

2nd Rev. SO 76, Am. 1—Change in reference to applicable price regulation.

SO 94, Order 41—Ceilings on new and used gasoline and oil drums sold by U. S. Govt.

Region III Order G-2—Retail ceilings on certain steel containers in Cleveland Region.

RO 1A, Am. 96—Tire certificates, records, and reports.

RO 5C Am. 182—Transferor required to obtain Form R-541 upon delivery of gasoline to dealer.

WPB—War Production Board

M-384 as am. 3-27-45—Lead chemicals.

Pri. Reg. 1, Interp. 13—Applicability of WPB regulations to used or second-hand materials and products.

CMP 5, Direction 26—Second quarter limitation on purchase of steel for MRO.

ODT—Office of Defense Transportation

AO ODT 6B, Am. 3—Cadillac ODT field office discontinued.

Am. 4—Fort Wayne ODT field office discontinued.

WMC—War Manpower Commission

Reclassification of Labor Market Areas—Critical labor shortage areas.

NWLB—National War Labor Board

Directive Order Estab. War Shipping Panel, Am.—Nearest office of Wage & Hour Division transmits applications to Panel.

GO 31 as am. 3-19-45—Wage rates in excess of minimum.

FPC—Federal Power Commission

Docket G-580, Order—Opening date of hearing in natural gas investigation postponed.

Treasury Department

Letter of Comm. of Int. Rev.—Intangible drilling cost decision.

Director of Procurement's Specifications (Federal Standard Stock Catalog)—Steel drum specifications.

USCCA—United States Circuit Court of Appeals

Case 11167, Decision—Drilling costs must be charged to depletion rather than expenses.

ICC—Interstate Commerce Commission

Rev. Service Order 263, Am. 3—Term of Service Order 263 extended.

USCG—U. S. Coast Guard

Tank Vessel Regulations—Inspection and certification of tank vessels.

CODE: AO—Administrative Order; CMP—Controlled Materials Plan; D—Directive; FDO—Food Distribution Order; GMPR—General Maximum Price Regulation; GO—General Order; Interp.—Interpretation; L—Limitation Order; M—Conservation Order; MPR—Maximum Price Regulation; P—Preference Rating Order: PAO—Petroleum Administrative Order: Pri. Reg.—Priorities Regulation; Proc. Reg.—Procedural Regulation; PS—Price Schedule; RO—Ration Order; RPS—Revised Price Schedule; SO—Supplementary Order; SR—Supplementary Regulation.

Digest of Week's War-Oil Orders

Office of Price Administration

CEILINGS ON RUBBER GRADES OF NON-SPECIALTY FURNACE CARBON BLACK PRODUCED FROM PROPANE—GMPR, Order 50 under § 1499.19a—Sales to DSC by producers may be made subject to adjustment upward in accordance with possible OPA-granted increase at time any such increase becomes effective. Issued and effective 3-24.

EXCEPTIONS TO RSR 1's JURISDICTION—GMPR, RSR, Am. 96—Deletes a part of the references to RMPR 136 (machines and parts) paragraphs covering products excluded from RSR 1's jurisdiction, since new MPR 581 (*see below*) now covers these products. Issued 3-26, effective 3-31.

CERTAIN MACHINERY SERVICES EXCEPTED FROM RSR 11's COVERAGE—GMPR, RSR 11, Am. 57—RSR 11 does not apply to any lease by DSC which is excluded from provisions of MPR 67 (new machine tools) or RMPR 136 (machines, parts, and industrial equipment). Issued 3-26, effective 3-31.

TRUCKING COSTS MAY BE ADDED TO PRICE OF EXCESS OIL COUNTRY TUBULAR GOODS—RPS 49, Am. 30—A holder of excess stocks of oil country tubular goods may include in his selling price transportation charges, at the commercial trucking rate, from the nearest railroad siding to the location of such material. Issued 3-27, effective 4-2.

STRIPPER WELL PREMIUM PAYMENT PLAN INCREASES REMOVED FROM RMPR 436 TO A SEPARATE REGULATION—RMPR 436, Am. 12—Price increases under the stripper well premium payment plan and the conditions and qualifications of such ceilings will hereafter be contained in a separate order to be issued as of April 2. Issued 4-2, effective 3-1.

CEILINGS ON INDUSTRIAL SERVICES—MPR 581—New Regulation 581 covers repair and maintenance services on products covered by MPR 1 (secondhand machine tools), RMPR 136 (machines, parts and industrial equipment), and MPR 465 (used pressure vessels and used enclosed atmospheric pressure vessels) besides many jobbing shop operations on metal, etc. Automotive, construction, road maintenance, and farm equipment repairs are not covered, but remain under RMPR 165 and MPR 134, as before. Detailed instructions are set forth for determining ceiling, filing reports with OPA, and securing adjustments of maximum prices in cases of hardship. Appendix A (Form OPA 694-2169) contains the form for applications for adjustment. Issued 3-26, effective 3-31.

CHANGE IN REFERENCE TO APPLICABLE PRICE REGULATION—2nd Rev. SO 76, Am. 1—Supplementary order providing for pricing of all of a supplier's services under one regulation changes its reference to MPR 136 (machines and parts) in two places to refer to the new regulation governing industrial services—MPR 581, (*see above*). Issued 3-26, effective 3-31.

CEILINGS ON NEW AND USED GASOLINE AND OIL DRUMS SOLD BY U. S. GOVT.—SO 94, Order 41—26c, regardless of condition, is the as-is ceiling set for sale to wholesalers or reconditioners by various government agencies of new (somewhat damaged) and used 5-gal. gasoline and oil drums of 22-gauge steel, with 2-inch flanged opening. Wholesalers' prices to retailers or industrial users are set at 70c delivered by truck within 50-mile radius, with actual transportation costs added for mileage above that; delivered by rail the ceiling is 70c f.o.b. location of drums. Retail ceiling is $1.10, seller's location. Wholesalers' price to retailers or industrial users for drums having serviceability less than that of new drums is 35c f.o.b. location of drums. Customary cash discounts must be maintained. Retail tags are required, and notification of required posting of retail ceilings must appear on wholesale invoice. Issued 3-28, effective 3-29.

RETAIL CEILINGS ON CERTAIN STEEL CONTAINERS IN CLEVELAND REGION—SO 94, Region III Order G-2—8c retail ceiling set in Region III for steel containers 6 in. deep, 3¼ in. in diameter, with lids, coated with aluminum-pigmented paint, when purchased from Material Redistribution & Disposal Office of Navy Dept., Philadelphia. Issued and effective 2-14, filed 3-21.

TIRE CERTIFICATES, RECORDS, AND REPORTS—RO 1A, Am. 96—Newly added are definitions of "manufacturer's establishment," "factory," "regional branch" (wholesale and mileage), and "sectional warehouse." Manufacturers must report all addresses of each of their factories and wholesale regional branches and of each main office of mileage regional branches to OPA Tire Rationing Branch, Washington, by 4-25-45, and keep them advised of any new factory or regional branches. Detailed rules are set forth for operation of sectional warehouses and the transfer to them of tires, for forwarding of replenishment portions, and inventory rules and statements of tires not yet transferred to dealers or consumers. An agent must be appointed for each sectional warehouse. Not over 75 wholesale regional branches and sectional warehouses may be maintained by a manufacturer at any time. Factory or regional branches may, without certificate, transfer Grade I tires to another manufacturer's establishment, other than sectional warehouses. Rules are tightened as to immediate voiding of replenishment portions by manufacturers, and for cancellation of orders by manufacturers. OPA Form R-65 must be filed by factory and regional branches by 20th of each month along with replenishment portions at OPA Verification Centers. Manufacturers must mail on same date to Washington OPA a separate report on R-65 for each factory

OIL-LAW-Gram Service

Complete texts of all orders or amendments digested in war-oil orders can be had from Platt's Oil-LAW-Gram, 1213 West 3rd street, Cleveland 13, Ohio. Minimum charge single copies $1. Copies of these texts are always in stock but large orders can be promptly filled by reprinting as plates and stencils are also kept.

Complete daily Oil-LAW-Gram service, with necessary binders, $100 per year in advance.

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and regional branch. Rules for reporting of new Grade II truck and Grade III passenger tire transfers are outlined. Issued 3-19, effective 4-1.

TRANSFEROR REQUIRED TO OBTAIN FORM R-541 UPON DELIVERY OF GASOLINE TO DEALER—RO 5C, Am. 182—Transfers forbidden unless Form OPA R-541 accompanies the coupons. Form must be retained at transferor's place of business for at least one year. When transfers are based upon delayed surrender of evidences and the form does not accompany the coupons, the transferor is required to make a diligent effort to obtain the summary, and must notify District Office of transferee's failure to deliver it. Issued 3-29, effective 4-2.

War Production Board

APPLICABILITY OF WPB REGULATIONS TO USED OR SECONDHAND MATERIALS AND PRODUCTS—Pri. Reg. 1, Interp. 13—Unless the regulation expressly states otherwise, all WPB orders apply to used and secondhand materials (other than scrap) to the same extent as to new items. Issued 3-27.

LEAD CHEMICALS—M-384 as am. 3-27-45—No change in amount of lead permitted to be used in insecticide manufacture. Except for tetraethyl lead use or manufacture, not more than 50% of the lead used during first six months of 1944 for petroleum or petroleum products processing, reprocessing, or alteration and for sweetening of kerosine or gasoline shall be put into process in any calendar quarter, or 1000 lbs. per quarter, whichever is greater. Quarterly reports to WPB Chemicals Bureau are required the 20th of each month following a calendar quarter by all persons putting into process over 1000 lbs. of lead for the uses for which quotas are assigned by M-384, including among others that of rubber compounding, which has same quota restrictions as has petroleum processing. Issued 3-27.

SECOND QUARTER LIMITATION ON PURCHASE OF STEEL FOR MRO—CMP Reg. 5, Direction 26—80% only of 1944 second quarter MRO steel quota is permitted for second quarter of 1945, and orders in excess of this must be cancelled or reduced. Persons ordering for delivery less than 10 tons carbon steel and two tons alloy steel are exempt. Issued 3-28.

Office of Defense Transportation

CADILLAC AND FORT WAYNE ODT FIELD OFFICES DISCONTINUED—AO ODT 6B, Ams. 3 and 4—Am. 3 issued 2-15, effective 3-15; Am. 4 issued 3-22, effective 4-1.

War Manpower Commission

CRITICAL LABOR SHORTAGE AREAS—Reclassif. of Labor Market Areas—Meriden, Conn., Pascagoula, Miss., Racine, Wis., Savannah, Ga., and Ventura-Oxnard, Calif. removed from Group I to Group II. Moved up from Group II to Group I are: Anderson, Ind., DeKalb, Ill., Grand Rapids, Mich., Indianapolis, Ind., Jackson, Mich., Perth Amboy, N. J., Peoria, Ill., Toledo and Youngstown, Ohio. Issued 3-20.

National War Labor Board

NEAREST OFFICE OF WAGE AND HOUR DIVISION TRANSMITS APPLICATIONS TO PANEL—Dir. Order Estab. War Shipping Panel, as am.—Applications for approval to voluntary wage and salary adjustments within jurisdiction of Panel are to be filed with nearest office of Dept. of Labor Wage & Hour Division, which will transmit them directly to the Panel. Approved 3-19, filed 3-24.

WAGE RATES IN EXCESS OF MINIMUM—NWLB GO 31 as am. 3-19-45—New establishments, or new departments in existing establishments may, after the first year of operation, if employer has plan properly in existence which operates so that a percentage of employes other than 25% may be hired at rates above appropriate minimum rates, continue such plan in effect. Issued 3-19, filed 3-28.

Federal Power Commission

OPENING DATE OF HEARING IN NATURAL GAS INVESTIGATION POSTPONED—Docket G-580, Order—To permit state conservation authorities to prepare data properly, the May 1st hearings in Kansas City have been deferred to a time in the late summer or early autumn, to be announced later. Issued 3-24.

Treasury Department

INTANGIBLE DRILLING COST DECISION—Letter of Comm. of Int. Rev.—Bureau of Internal Revenue will follow Bureau regulations, permitting charging of drilling costs to expenses, rather than depletion, regardless of recent Fifth Circuit Court of Appeals decision, pending a clarification of the law. Any changes are not to be retroactive unless so directed by Congress. Issued 3-29.

PROCUREMENT DIVISION SPECIFICATIONS—Federal Standard Stock Catalog Specifications for Steel Drums—Outline of specification RR-D-729, Drums: Type 5-B for Petroleum Use was given on page 52 of last week's (March 28) NPN. It eliminates separate drum specifications of air forces, Quartermaster Corps and Navy Dept. Issued 2-2, released 3-26, effective 4-15.

U. S. Circuit Court of Appeals

DRILLING COSTS MUST BE CHARGED TO DEPLETION RATHER THAN EXPENSES—5th Circuit Court Ruling, Case No. 11167—*(Full text of ruling in March 28 NPN, pages 53-54).*

Interstate Commerce Commission

TERM OF SERVICE ORDER 263 EXTENDED—Rev. Service Order 263, Am. 3—Expiration date of order governing demurrage charges on tank cars now set for June 1, 1945. Issued 3-23, effective 4-1.

U. S. Coast Guard

INSPECTION AND CERTIFICATION OF TANK VESSELS—Tank Vessel Regs., as am.—Detailed amendments made to rules governing inspection of vessels carrying inflammable liquids and gases, combustible liquids, etc. in coastwise traffic. Rules for reports of accidents to tank vessels are included. Issued 3-23.

14 Pools in 7 States Get Stripper Subsidy

NPN News Bureau

WASHINGTON—OPA this week announced increases ranging from 17c to 35c per barrel had been granted in ceiling prices of 14 pools under the stripper well premium payment plan. Increases were effective March 1.

Nine of the pools were granted increases because investigation showed that average daily well production was less than 9 bbls. either during December, 1943, or the year preceding application for inclusion in the plan.

Five pools were added under the high-cost provision of the plan, which allows price increases where daily average per well production is more than 9 b/d but production costs exceed existing ceilings.

At the same time eleven pools were listed that cannot take any increase in ceiling prices under the stripper plan. These pools are in counties that have been given county-wide increases but are excepted from increases because they were discovered after Jan. 1, 1944. Pools denied subsidies, all in Texas, are Garrett, Holliday, Luke, Ord, Williams, Woodbine, Ellis-Strawn, Noodle Central, Batchler, Ewalt and Walsh.

The 14 new pools, and the amount of their increases, follow:

Pool	State	Increase /Bbl.
Dexter	Kansas	.25
Faubin	Kansas	.25
Hammer	Kansas	.20
Deerhead-Viola	Kansas	.35
Valley Center	Kansas	.35
Naval Reserve South	Oklahoma	.20
Haydenville (Dutcher)	Oklahoma	.25
Jesse (Gilcrease)	Oklahoma	.25
East Lusk	New Mexico	.35
Loco Hills	New Mexico	.17
Carey	Mississippi	.33
Patton	Illinois	.35
Reed	Kentucky	.20
Harper	Texas	.20

Action was taken in Amendment 12 and Order 37 under RMPR 436, effective March 1.

Coming Meetings

APRIL

NPN's Oil Marketers Convention-in-Print, proceedings of the fourth session April 11.

Independent Petroleum Assn., mid-year meeting of the Board of Directors, New Orleans, La., April 9-10-11.

OCTOBER

Indiana Independent Petroleum Assn., fall convention, Hotel Severin, Indianapolis, Oct. 10-11.

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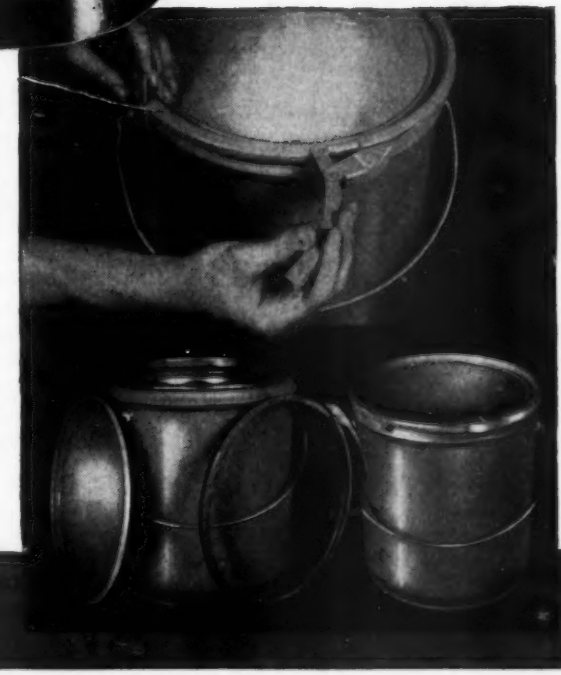

(*Continued from p. 7*)

dispersion additives react in a similar manner in the oil. Only a fraction of 1/100 of a percent is sufficient to break the bubbles and cause a rapid dissipation of the air whipped into the oil by circulation or the crankshaft throws. Foaming is hard to detect as an inspection of the dip stick is not always sufficient. However, foaming does cause a build-up of crankcase oil temperatures caused by

lesser cooling capacity of the air-oil mixture foam.

The four foregoing characteristics will, in one way or another, reflect their needs for post-war motor oils. Various engine test standards, such as the 36-hour Chevrolet Engine Test L4 Method, or its modified form with slightly lower crankcase oil temperature, or the various Caterpillar engine test requirements, or those of new makes of future passenger car or truck radial or pancake engine test procedures, will confront you and your oil. Only by such engine tests can the properties of detergency, dispersion and oxidation resistance in all its forms be assured and the proper selection of the base stock, proper method of refining and suitable efficient additives be blended to the correct mineral base oil to make tomorrow's motor oil.

AIRCRAFT OIL

Today the world's leading industry is aircraft. It is certain that as a postwar industry it cannot maintain that posiion but it can support 8% to 10% of the present volume which would be a growth of 1000% over 1938. The acceptance by the general public of civilian aircraft is one of your most future concerns as airline and military use of aircraft lubricating oils are national and international in scope, so out of your sphere of selling. The younger generation is taking to flying as we did to the automobile and they represent a great future potential market to the petroleum industry. Many executives are also planning planes for their companies' post-war. In 1940 there were actually about 25,000 light planes used in private flying. Eight to ten years after the war it is estimated that there should be about 300,000 to 400,000 small planes and a yearly production of 20,000 to 40,000 such planes shortly after the war.

For the first five years after the war the volume of aircraft lubricating oil will be small as compared to your motor oil sales, probably 3% to 5%, but if you are to develop this market the proof that you have an oil of aircraft quality is one of getting into this field from the very start.

Just how much policing outside agencies, such as the CAA, will play or whether only aircraft engine manufacturers' approvals will prevail, is a part yet to be determined. It is a known fact that 95 Viscosity Index Minimum still is a requirement and Pennsylvania Aircraft Oils for World War II are tops, such as was the case in the last World War I. Even though the temperatures of the cylinders are higher, the horsepower per cubic inch is greater and the octane numbers are greater than 100, mineral oils are used in preference to additive type aircraft oils of equivalent SAE numbers and VI. Oxidation resistance to lacquer, corrosion and viscosity build up, as well as sludge and low engine wear, are of utmost importance.

GEAR LUBRICANTS

Even more impressive perhaps than other lubricants is that of the All-Purpose Noncorrosive Gear Lubricant. Originally designed to fill Army requirements for minimum inventories and ease of application, this product is beng developed to meet dealer and commercial requirements. Such products require a very stable mineral oil to which are added certain film strength additives which will handle the high rubbing gear tooth speeds of the passenger car, and yet give low tooth wear in high torque truck and tractor service.

Such all-purpose gear lubricants must have oxidation resistance of straight mineral or motor oils and absence from corrosion during usage and with all kinds of metals met with in the transmissions or rear axles of our present and future cars and trucks. These lubricants have definite character, based on service performance yardsticks rather than physical tests or specifications, as written in the past.

Chassis and wheel bearing greases are undergoing even greater changes of manufacture than lubricating oils. The war has put new emphasis on the development of all types of greases. It has forced research in grease development in the past two years to more advances than in all the last 10 years. Just now with powder dry soaps and continuous methods of heating and cooling apparatus available, our existing kettle methods in making grease, whether soda, aluminum or mixed base, will be absolute in another five years. Of course, future design of wheel bearings, chassis fittings and bearings will advance. Some pre-

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dict the self-sealed bearings, such as used in aircraft, but this should not upset your dealers as they will be giving a wider range of service to the motoring and flying public than chassis, gear and motor oil lubrication.

HYDRAULIC FLUIDS AND LUBRICANTS

The aircraft industry's development of hydraulic lubricants and fluids, coupled with the recoil requirements of Army and Navy Ordnance, not to mention the fluid drive of our splendid tanks, have given the automotive engineer and the petroleum industry a new concept as to what constitutes a hydraulic oil. The postwar car, truck and bus will tend toward fluid drive which requires oils of low temperature-viscosity change and with fairly high resistance to oxidation. Whether the Heavy Duty 10W Motor Oils, such as now used, or whether sub-zero hydraulic oils, such as called for by aircraft control mechanism, is a matter of postwar design revealed when the automotive industry exposes its hand during 1946 and the following years.

NEW RUST PREVENTIVES

Never before has the problem of rust and rust losses, which were accepted as a nuisance, resulted through the war in developing petroleum products to eliminate and safeguard equipment. The necessity of treating mechanical equipment against rusting is, of course, obvious. The types vary widely and they are designed to meet specific conditions of operation, storage and shipment. Farmers are using the general purpose rust preventive oil, whereas truck and tank manufacturers are filling the crankcase of new equipment awaiting storage or shipment with the crankcase or motor oil, SAE 10 and 30 grades of rust preventive lubricating oil. These grades are also suitable for winter storage of marine engines.

As a postwar contribution these rust preventive lubricating oils, greases and waxes will preserve the hundreds of millions of dollars of automotive, ordnance and marine production equipment, as well as the vehicles and motive power made obsolete by the ending of World War II. These rust preventive products will also be part of our civilian conservation program of the future.

You can see by the foregoing that the horizon is bright for those that are prepared to meet these new changed conditions.

Fears for Excess Light Oil Output on Price Structure

CHAIRMAN TAYLOR—Thank you Mr. Larson. Even I understood what you were talking about. So I am sure it didn't go over the heads of our audience. I know they appreciate your clear, concise and understandable discussion on this important postwar question.

I am sure that Mr. Larson will be glad to answer any questions now, or after the meeting. Drop them in our

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KILLS FIRE in seconds

Here in four simple hand movements we come to grips with modern fire protection. Carbon dioxide gas, the fastest non-damaging fire extinguishing agent, is stored under high pressure in portable cylinders. The rapid release of the fire killing gas with the new SQUEEZ-GRIP valve saves time and gas. There is no wheel to turn. No need to set the cylinder down to operate it. C-O-TWO gas can be discharged or stopped as quickly as you can close or open your hand. In fact, it's so easy to use that even a woman or a child can operate it and extinguish a fire in seconds.

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question box. I will see that he gets them.

I note that George Haering, president of the Arkansas Independent Oil Marketers' Assn. and head of the Haering-Vance Oil Co., Hot Springs, Ark., wants the floor.

MR. HAERING—I think one of the most important problems facing our industry today is the subject of "Excessive Production of Light Oils during the beginning of the postwar period. How can we combat this in our marketing without the complete destruction of basic price structure? I feel that the only way to avoid this would be for refiners to reduce their runs to conform with supply and demand. I would like to hear a discussion on this.

MR. TAYLOR: That Mr. Haering is one of the hottest subjects in the oil business today. It is too big to pass off lightly in this meeting. I know that I have asked many oil men the same question. The reply has invariably been, "I wish I knew".

I know that there are a lot of ideas on the subject, and I am reasonably sure that out of this group of a great many thousand oil men, we will be able, at least, to get some ideas. Whatever comes up will be given in a future session of this convention.

Thank you for bringing this up, Mr. Haering. Do you have any other questions?

MR. HAERING: Yes I do. I would like to have some discussion on the subject of "Advisability of marketing of other than accessories and petroleum products through service station outlets, and the advisability of incorporating purchasing companies to buy diversified lines of merchandise for resale to petroleum marketers at the conclusion of hostilities."

MR. TAYLOR—I see that attending this convention is Walter Hochuli, director of the distribution and marketing division of PAW. I know of no one better qualified to discuss this subject than Walter Hochuli. His broad experience as a major oil company marketing executive before the war, and his successful experience in PAW, certainly qualifies him as an "expert".

Therefore, I am assigning this subject to him to be presented at a coming session of this convention.

In the meantime I see that our anonymous friend "Mac", who has made his living for many years, and quite successfully, too, working with jobbers, looks like he might have something to say, right now on the subject. How about it, "Mac"?

Right Combination of Extras Has Paid Off Handsomely

"'MAC'"—Two plus two equals four in our arithmetic. . . .

In theory tires, batteries, and accessories plus gasoline, fuel oil, kerosine and motor oil equals "Four" in profits and the formula has been proved to be accurate by many progressive jobbers of petroleum products—some jobbers have shown that that combination properly exploited has added up to more than "four" in profits.

Others—and some very successful jobbers too—have proved it to be **zero** because they have constantly and consistently refused even to consider the adding of "other items" to petroleum. In one instance the jobber has been very efficient in planning the delivery of petroleum products and has therefore shown a very low delivery cost per gallon and has been afraid that the adding of other items will increase his costs and reduce his profits.

Another jobber stated that he had made $2000 net profit on tires in one fall month (he sells approximately 3,500,000 gal. of gasoline annually) and made no profit on gasoline or oil. The reason was in accounting; he did not charge any of the expense to tire sales, in spite of the fact that the tank trucks delivered all of the tires in the regular course of gasoline deliveries.

Oil jobbers cannot be "classified" easily because of the wide difference in ability, capital, location, and potential, all of which affects volume of sales.

In a few cases the jobber has had "eyes larger than his stomach" and has expanded into other than "kindred" lines; with disastrous results in some cases. For example the jobber who stocked a line of household radios, electric refrigerators, and vacuum cleaners, all of which required a service he was not equipped to give, with the result that he lost many good petroleum customers and did not make any profit on the "outside lines".

Some jobbers have based the decision NOT to sell tires, batteries and accessories on the results of the few who had the adverse experience, but the jobbers who have confined the operation to "kindred lines" in the main, have been successful. For many years ice and coal have been sold profitably, as complementary items by many successful companies; sold in opposite seasons coal and ice are not always sold to identical customers but the planning is almost always done by one man who sets up the marketing activity over a 12-months period and employing the same organization, in the main for both products.

The petroleum jobber with capital and ability to organize, can and does sell tires, batteries and those accessories for which the demand is great enough to produce a satisfactory volume—spark plugs for example can be sold in profitable volume, while certain specialties such as polish or sun glasses, which are not absolute necessities to all cars are apt to be slow movers.

Preparing for Price Cut

In postwar planning, most jobbers are giving serious consideration to "extra profit items", because with the increase in refinery capacity and the end of the war demands, every one in the industry can see a supply in excess of the immediate demand, which will no doubt "soften" the price of gasoline and when the consumer's price is reduced, the jobber absorbs part of the reduction in narrower margins.

Taking a leaf from the book of the major companies, it is generally true that the tire companies did not make a howling success of the gasoline and oil business. The general opinion is that the tire companies were "too tire-minded" and the tire men never did learn the oil business from the customer's view point.

One major oil company started to market tires in the early 30's by installing a tire department parallel to the oil marketing department. Today (15 years later) the tire men have all been absorbed by the oil marketing departments and even the head of the tire sales is an "oil man". From that company's experience as well as many others it would seem to be better to teach an oil man to sell tires rather than to attempt to fit a tire man into the oil business. There are exceptions of course and the individual selected has a direct effect on the results accomplished.

The reasons which prompted the major companies to install a "T B A" department apply in the same manner to jobbers' operation:

First:—A typical example is the ex-

perience in an average station in a medium-sized town: The station had no lubritorium but did have a modern lift. The oil sales which were better than average over quite a long period, started a steady decline. The operator soon discovered that whenever a car came into the station with one or more new tires, that under the hood was also an "oil sticker" from the same station that sold the brand of tires that were on the car. He also discovered that the "deal" for tires not only included an oil change but in many cases the buyer—his old customer—has bought five gallons of motor oil; this was enough for three changes and some left over to add, between regular changes. The dealer reasoned—correctly—that if he had sold the tires himself his customer would have had no reason to drive into the other station.

Second: A station location, which would produce a good volume, also carried a higher rental or purchase price and the extra profit from other items was needed to help pay the overhead.

Third: Most good stations had "peak loads" of business once or twice a day and the same men that worked on the island in the rush hours could sell and mount tires in the more or less slack periods of the day.

Fourth:—When a station was improved with a lubritorium and merchandise was properly displayed sales were easier to make because the buyer quite often hung around while his car was being serviced and the lubrication man had a chance to talk to him about what he actually needed for his car. (Everyone in the business agrees that it is easier to sell a customer who is walking around in the "store" than the man who is in his car on the driveway and in a mad rush—imaginary or otherwise).

Meeting Outside Competition

All of these reasons apply not only to the major company but to the jobber operation as well. Another reason that applies more particularly to the jobber is the matter of competition from outside suppliers. The trend is toward control of retail outlets, both by the major and the jobber. Most majors and a large percentage of jobbers have some plan of marketing the "T B A" line and the wide-awake dealer realizes that he needs the line and the jobber cannot refuse to let him sell other items even if the jobber controls the location. Therefore if the jobber himself does not supply his dealer, some other supplier will supply him and a wide-awake salesman will slip in a little (at first) motor oil and then a little grease—products that the jobber should supply himself.

Methods of procedure have differed in different areas, depending on the potential volume. Sales through direct operation and dealers' stations have followed the pattern of the oil and grease sales. Sales to farmers, however, have been made by adding a commission for the

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Transport truckers—large industrial users—individual car owners—farmers are enthusiastic about the *super-service* Lubri-Gas Treated Fuel gives them when used in their trucks, diesels, passenger cars, tractors and other motorized equipment. They report that Lubri-Gas eliminates sticky valves, removes carbon, saves repair bills, and adds extra miles per gallon consumed. Motors run cocler and last longer with Lubri-Gas.

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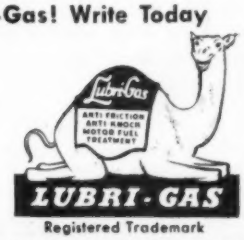

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Cleans and Lubricates as It Powers Your Motor

tank truck driver to the salary already paid. And all jobbers who have used this method have been able in a fairly short time, to secure a very satisfactory volume.

Credit (which of course is a large subject and quite a problem to some jobbers) has been used successfully—both open line and installment or budget plan; and with proper followup the losses have been low.

Today the jobber who is seriously looking ahead to the postwar market is not thinking about whether to go into "T B A" or not to go in but he is thinking about *how* to go in, because he can see from here that two plus zero equals two and two plus two equals "four" and that "four" is his profit.

Listing Some Added Lines Which Have Proved Worthy

MR. TAYLOR—Thank you, "Mac". That was very interesting. I am sure that some of our marketing friends got some good thoughts out of your talk.

Does anyone else have anything on this subject? Ah, I see we have quite a few hands. We will take you gentlemen, in order, as fast as we can in the limited time remaining. Simply give your name and company and tell what added lines you have gone in for.

AUGUSTUS GREST, secretary-treasurer, Boyertown Oil Co., Boyertown, Pa., wheel alignment and spot vulcanizing.

R. A. LUHMAN, owner, P. O. Co., Detroit, mufflers and tailpipes.

GEORGE BECK, owner-proprietor, Becks Shell Service, Ashland, Ohio, car and home accessories, tires-tubes and recapping.

R. A. COSTNER, owner, Costner Oil Co., Lincolnton, N. C., coal and auto insurance.

J. R. WEIBER, Viking Oil Co., Coleraine, Minn., all available specialties and accessories.

R. E. PITCHER, North Branch Oil & Gas Co-op, North Branch, Mich., tire vulcanizing. Customers appreciate this service, although help to get this work done is hard to get.

J. L. BAXTER, manager Kleis service, St. Cloud, Minn. We stock whatever is requested from rear view mirrors to band-aids and adhesive tape.

G. F. TAYLOR, JR., partner, Taylor Oil Co., Somerville, N. J. We have stocked razor blades. They sell 25 blades for a dollar. This is six months shaving comfort. I give each man with a beard a sample blade. **Sixteen out of 24 blades given away sold a dollar item.**

C. J. PECK OIL CO., Hattiesburg, Miss., tires, batteries, and all kinds of accessories.

M. SHAFER, Orion Gas & Oil Co., Lake Orion, Mich., vulcanizing equipment and batteries.

J. M. LINNAN, president, Dennis Petroleum Corp., Kenmore, (Buffalo) N. Y., spark plugs, cleaning and polishing products, and all accessories available.

A. JONES BIVENS, owner, Bivens Oil Co., Pawtucket, R. I., we have, and shall continue, to add anything automotive on which our dealers can make added profits.

BILL COOZE, owner, Bill Cooze's Service, Pueblo, Colo., retailing and wholesaling of batteries, tires, filter packs, and many other items. We have never quit giving excellent service to our old and also to the new customer. We still don't have to be asked to give service. Our customers swear by us—not at us.

R. E. TAYLOR, Winston Salem, N. C., tires and accessories.

C. S. HOPSON, Hopson Oil Co., Waukesha, Wis., light auto repairs.

HERMAN FELDMAN, president, Jefferson Oil Co., Saginaw, Mich., we have added everything needed, and available for service stations.

N. A. BARTON, Riblet Oil Co., Youngstown, Ohio, complete line of accessories.

C. B. PARRISH, general manager, Glenn Oil Co., Muncie, Ind., wheels, rims, brake service and other truck supplies.

MR. TAYLOR—Gentlemen, that is all we have time for this session. I believe we could take up our entire meeting time telling of the added lines taken on by oil marketers. Many of them have told us around the convention of their plans for an expanded T.B.A. business. This will be discussed further in future meetings.

° ° °

Ladies & Gentlemen, don't forget that this is your convention. If you have any ideas, write them down and drop them in the "suggestion box". Address, "NPN Convention in Print, Room 31, 5th Floor, Penton Bldg., Cleveland 13, O.

Our next session will be devoted to transportation, with one of the country's leading oil transportation experts as the guest speaker. Many vital problems of interest to oil marketers will be discussed.

The convention adjourned until next week, April 11.

° ° °

PREPARED FOR ESPA

The talk in this week's convention-in-print by C. M. Larson, was originally prepared for delivery at the Empire State Petroleum Assn. meeting, which was cancelled.

° ° °

Cocktail Hour Department At the Convention-in-Print

S-h-h—Did you hear this one?

WHEN I DIE.

When I die, please bury me deep,
Beneath a mountainous tire heap.
Plant rubber trees around my grave,
An auto-shaped mound is what I crave.
Instead of a tombstone at my bean
Put tanks of oil and gasoline,
So my poor soul may travel free,
Unbothered by priority.

° ° °

HEARD AT THE HOTEL

Did the drunk in room 13 disturb you?
No—but the mosquitos after biting him came to my bed with the hiccoughs.

° ° °

An oil man fell in love with an actress and decided to marry her, but to make certain of her reputation he employed a private detective to report on her life.

Report: The lady has an excellent reputation, her past is without blemish, she has an excellent circle of pleasant friends. The only breath of scandal is that lately she has been seen a great deal in the company of an oil man of doubtful repute.

° ° °

Send your refined—not crude—convention jokes to NPN's Convention-in-Print Editor. For all accepted, we will send the author a prewar Camel package (empty).

It Ends Overflow Waste

FARATRON ELECTRONIC OIL LEVEL CONTROL unfailingly controls the exact level of oil (crude), gasolene or any similar product in any type of tank, bulk storage or processing apparatus.

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Market Reports

ATLANTIC COAST—Only one supplier is now posting 8.5c for 70-74 oct. gasoline in barges at New York harbor, the ceiling which OPA has set for three primary suppliers. The 8.975c ceiling for other principal sellers remains in effect. One marketer involved in this low ceiling said he would sell in the open spot market at 8.5c but he was not posting a publication price for contract sales. Another of the three withdrew his barge price of 8.975c as a result of a controversy with OPA over the 8.5c ceiling. Gasoline supplies continued tight in most areas although Richmond distributor claimed no shortage and receiving 100% nominations.

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CALIFORNIA — No price changes were reported this week, and the market remained as it has been for the past three months. Heating oil and Diesel fuel remained extremely scarce. A total of 236 service stations re-opened during February in five Western states. Still closed are 4736 stations.

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GULF COAST—No price changes at Gulf points. Tank car availability was generally tight but ample tankers for shipments of Navy Diesel was reported by a New Orleans refiner. A slight easing in demand for light fuels was indicated but calls for heavy fuels by Eastern marketers were increased.

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MIDCONTINENT—Range of $0.90-0.97 quoted by two refiners on No. 6 fuel oil in North Texas was raised to flat 97c March 26, when one refiner withdrew his 90c posting. West Texas refiner reported open spot sales of No. 6 fuel oil, 25 cars to Dist. 1 and 25 cars to Dist. 2, both at 97c for April shipment in buyer's cars.

Gasoline demand continued increasing steadily. Burning oils demand is dropping but kerosine call is heavier due to brooder season, refiners say. Transportation remained unchanged generally, with refiners still short on tank cars.

Eleven cars Grade 26-70 natural gasoline reported sold at 4.75c f.o.b. Group 3. No open spot sales were reported f.o.b. Breckenridge; sellers quoted 4.375c during the week. However, price dropped f.o.b. Breckenridge March 31, when seller reported quoting 4.25c, two sellers quoted 4.375c April 2, grade 26-70 natural gasoline sold at 4.125c when seller reported sales of seven cars at that price; one seller quoted 4.375c.

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MIDWEST—No price changes. All refiners and marketers report that the peak of the seasonal demand for burning oils has been safely passed and that the spring demand for farm products will soon be hitting its stride. The market demand for residual fuel continues strong as major purchases go to war plants and the railroads. Gasoline supplies appear ample, although one refiner reported that in looking for 20 tank cars of regular, he had noted a slight tightening. Another refiner stated that refinery stocks of regular gasoline were good, but that with the opening of the Great Lakes transportation season soon, the refilling of marine terminals would bring a lowering of stocks held at refineries. Marketers report that third grade white gasoline is practically unobtainable for farm trade.

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PENNSYLVANIA — Price range of 6.875-7.175c remained unchanged when lower field refiner raised his price .5c to 7.175c for No. 1 fuel oil. This same refiner withdrew his posting of 6.875c for 36-40 grav. fuel oil for lack of material.

N.P.N. Gasoline Index

	Dealer T.W.	Tank Car
	Cents Per Gal.	
April 2	10.37	6.73
Month ago	10.37	6.73
Year ago	10.51	6.83

Dealer index is an average of "undivided" dealer prices, ex-tax, in 50 cities.

Tank car index is weighted average of following wholesale markets for regular-grade gasoline, FOB refineries or terminals: Okla., Mid-Western, W. Penna., Calif., N. Y. Harbor, Philadelphia, Jacksonville, Boston and Gulf Coast.

Daily Av. Pennsylvania Crude Runs

(Compiled by National Petroleum Assn. from reports of all companies refining Pennsylvania crude. Figures in bbls.)

Week Ended Mar. 24, 1945	Week Ended Mar. 17, 1945	Week Ended Mar. 25, 1944
60,927	55,592	68,791

CRUDE PRICES

Since changes in crude oil prices are so few, the two pages of crude oil price tables hereafter will be printed only when there are sufficient changes in prices to warrant.

In the meantime a record is being kept in the Cleveland office of NPN and OILGRAM from which the publishers will be glad to make proofs, or letters or affidavits as to what the prices are, and without charge to regular subscribers. Changes in crude oil prices will be specially noted in this market section when made.

Crude Price Changes

Gulf Refining Co. posted price for Ordovician crude from the Sand Hills-Ellenberger-West field in Crane County, Texas, beginning with Below 25 at $0.93 with 2c differential to 40 & Above at $1.25, effective March 1, 1945.

For latest table of crude prices published, see NPN, March 21, pages 49, 50 and 47.

Summary of Daily Gasoline Prices (March 26 to April 2)

	Monday April 2	Friday March 30	Thursday March 29	Wednesday March 28	Tuesday March 27
U. S. Motor (ASTM octane)					
76 octane Ethyl:					
Oklahoma	6.75	6.75	6.75	6.75	6.75
Mid-Western (Group 3 basis)	6.75	6.75	6.75	6.75	6.75
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7	7	7	7	7
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7 (2)	7 (2)	7 (2)	7 (2)	7 (2)
70-74 octane:					
Oklahoma	5.875	5.875	5.875	5.875	5.875
Mid-Western (Group 3 basis)	5.875	5.875	5.875	5.875	5.875
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.875	5.875	5.875	5.875	5.875
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.875	5.875	5.875	5.875	5.875
63-66 octane:					
Oklahoma	5.625 (1)	5.625 (1)	5.625 (1)	5.625 (1)	5.625 (1)
Mid-Western (Group 3 basis)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.625 (1)	5.625 (1)	5.625 (1)	5.625 (1)	5.625 (1)
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.625 (1)	5 625 (1)	5.625 (1)	5.625 (1)	5.625 (1)
60 octane & below:					
Oklahoma	5.25	5.25	5.25	5.25	5.25
Mid-Western (Group 3 basis)	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.25	5.25	5.25	5.25	5.25
Motor Gasoline, 70-74 oct.					
New York harbor	9.075	9.075	9.075	9.075	9.075
New York harbor, barges	8.975	8.975	8.975	8.975	8.975
Philadelphia district	9.075	9.075	9.075	9.075	9.075
Baltimore district	8.825	8.825	8.825	8.825	8.825
Motor Gasoline:					
Western Penna. Bradford-Warren:					
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.625- 8.225	7.625- 8.225	7.625-8.225	7.625- 8.225	7.625- 8 225
Western Penna. Other Districts:					
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.725	7.725	7.725	7.725	7.725

Note: To conform with Article IV of MPR 88 as amended August 15 we are substituting 70-74 oct. ASTM for the old 72-74 oct. ASTM. We continue to include in this group, Housebrand quotations.

REFINERY OPERATIONS

(American Petroleum Institute figures in thousands of barrels of 42 gal. each. Figures include reported totals plus estimate of unreported amounts and are therefore on a Bureau of Mines basis.)

Districts	Daily Average Crude Runs to Stills Week Ended		Gasoline Production at Refineries inc. Natural Blended Week Ended		Kerosine Production Week Ended		Gas Oil & Dist. Fuel Oil Production Week Ended		Residual Fuel Oil Production Week Ended		Total Stocks Kerosine Week Ended	
	Mar. 24	Mar. 17	Mar. 24	Mar. 17	Mar. 24	Mar. 17	Mar. 24	Mar. 17	Mar. 24	Mar. 17	Mar. 24	Mar. 17
East Coast	713	752	2,017	1,980	260	224	935	882	1,521	1,577	1,948	1,773
Appalachian (Dist. 1)	100	101	301	316	52	61	85	89	112	128	240	276
Appalachian (Dist. 2)	56	62	154	205	15	15	53	56	107	100	33	29
Ind., Ill., Ky.	770	785	2,920	2,804	278	266	640	620	1,031	1,182	1,372	1,360
Okla., Kans., Mo.	384	391	1,442	1,418	166	137	357	432	494	463	453	476
Inland Texas	233	223	967	904	75	89	122	106	442	404	140	140
Texas Gulf Coast	1,087	1,151	3,409	3,307	403	473	1,266	1,407	1,760	1,896	1,048	1,048
Louisiana Gulf Coast	284	276	752	762	274	262	268	332	369	308	918	1,086
No. La. & Arkansas	69	69	191	195	52	45	47	70	93	107	124	120
Rocky Mt. (Dist. 3)	10	12	31	36	4	4	7	8	22	23	15	15
Rocky Mt. (Dist. 4)	120	124	429	366	37	23	72	75	195	220	120	116
California	907	827	2,294	2,188	116	53	596	450	3,020	2,634	448	413
Total U. S.—B. of M. Basis	4,742	4,773	14,907	14,481	1,732	1,652	4,448	4,527	9,166	9,042	6,859	6,852
U. S.—B. of M. Basis, Mar. 25, 1944	4,466		13,221		1,472		4,785		9,195		6,476	

Districts	Total Stocks Gas Oil and Distillates Week Ended		Total Stocks Residual Fuel Oil Week Ended		Gasoline Stocks—Military and Other Week Ended		Gasoline Stocks—Civilian Grade Week Ended	
	Mar. 24	Mar. 17	Mar. 24	Mar. 17	Mar. 24	Mar. 17	Mar. 24	Mar. 17
East Coast	5,285	5,200	5,618	5,163	6,903	6,290	6,935	7,470
Appalachian (Dist. 1)	373	358	248	225	1,241	1,309	1,248	1,209
Appalachian (Dist. 2)	120	107	163	156	616	608	866	902
Ind., Ill., Ky.	3,351	3,226	1,846	1,973	6,778	6,864	17,461	17,139
Okla., Kans., Mo.	1,691	1,620	1,188	1,143	1,816	1,760	8,056	7,868
Inland Texas	335	304	599	615	1,279	1,230	1,806	1,904
Texas Gulf Coast	5,038	4,912	6,315	6,654	11,021	11,098	5,405	5,476
Louisiana Gulf Coast	1,903	1,779	1,502	1,420	2,413	2,599	2,627	2,463
No. La. & Arkansas	707	797	284	289	937	945	2,063	2,219
Rocky Mt. (Dist. 3)	15	15	30	27	20	20	65	64
Rocky Mt. (Dist. 4)	349	304	590	579	466	476	2,042	1,959
California	7,615	7,861	24,944	25,474	12,035	12,272	4,913	4,738
Total U. S.—B. of M. Basis	26,782	26,483	43,327	43,718	45,525*	45,471	53,487	53,411
U. S.—B. of M. Basis Mar. 25, 1944	30,925		52,475		35,189		50,394	

*Includes aviation, military, solvents and naphthas, and gasoline blending stocks currently indeterminate as to ultimate use, and 11,748,000 bbl. of unfinished gasoline this week, compared with 11,992,000 bbl. a year ago.

Percent Daily Refining Capacity Reporting—East Coast, 99.5; Appalachian (Dist. 1) 76.8, (Dist. 2) 81.2; Ind., Ill., Ky., 87.2; Okla., Kans., Mo., 78.3; Inland Texas, 59.8; Texas Gulf Coast, 89.3; Louisiana Gulf Coast, 96.8; No. Louisiana & Arkansas, 55.9; Rocky Mt. (Dist. 3) 17.1, (Dist. 4) 72.1; California, 85.5; Total U. S.—B. of M. Basis Mar. 24, 1945 85.5; Total—B. of M. Basis Mar. 17, 1945 87.5.

U. S. Crude Oil Production

(American Petroleum Institute figures)

	WEEK ENDED Barrels (Daily Average)	
	Mar. 24	Mar. 17
Oklahoma	369,350	368,950
Kansas	275,500	271,300
Nebraska	950	950
Texas	2,159,000	2,159,000
Louisiana	365,750	365,800
Arkansas	80,200	80,300
Mississippi	52,200	51,500
Alabama	250	250
Florida	15	15
Illinois	191,250	181,950
Indiana	10,350	10,300
Eastern (Ill., Ind. & Ky. excluded)	63,850	66,800
Kentucky	14,600	14,200
Michigan	51,050	50,100
Wyoming	105,300	105,600
Montana	20,550	20,650
Colorado	10,000	9,900
New Mexico	103,850	103,850
California	908,100	912,500
Total, U. S.	4,782,115	4,773,915

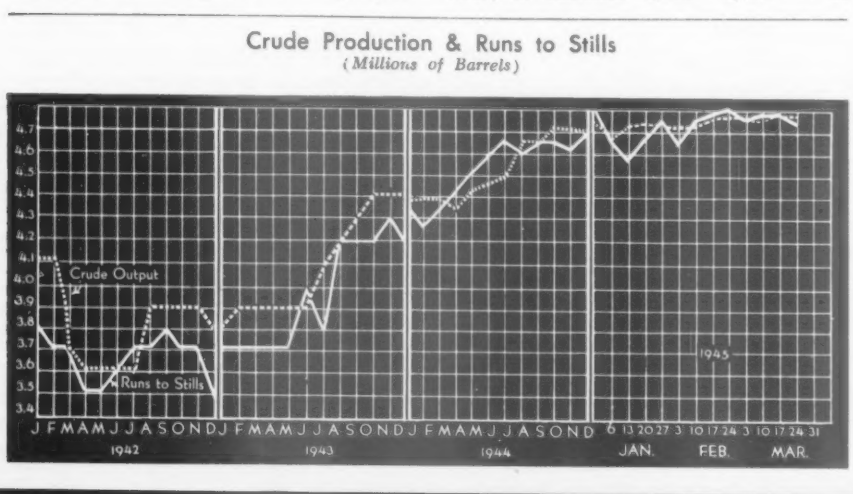
Crude Oil Stocks

(Bureau of Mines Figures in thousands of bbls.)

Grade or Origin	Mar. 17	Mar. 24	Change from Mar. 17
Penna. Grade	2,221	2,221	
Other Appalachian	1,191	1,273	+ 82
Lima-Michigan	954	948	— 6
Illinois-Indiana	14,201	14,157	— 44
Arkansas	2,696	2,672	— 24
Kansas	8,468	9,014	+546
Louisiana:	13,046	12,862	—184
Northern	3,189	3,142	— 47
Gulf Coast	9,857	9,720	—137
Mississippi	909	1,155	+246
New Mexico	6,779	7,058	+279
Oklahoma	30,203	30,674	+471
Texas:	110,285	110,682	+397
East Texas	18,354	18,013	—341
West Texas	31,464	31,607	+143
Gulf Texas	31,667	31,887	+220
Other Texas	28,800	29,175	+375
Panhandle	5,205	5,385	+180
North	7,389	7,394	+ 5
South	6,574	6,926	+352
Other	9,632	9,470	—162
Rocky Mountain	6,511	6,309	—202
California	20,015	19,993	— 22
Foreign	2,007	2,209	+202
Total gasoline-bearing in U. S.	219,486	221,227	+1,741
Heavy in California	5,783	5,715	— 68

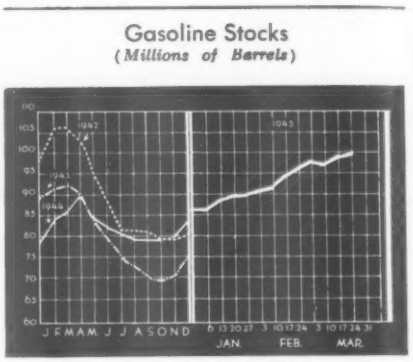
Crude Production & Runs to Stills

(Millions of Barrels)



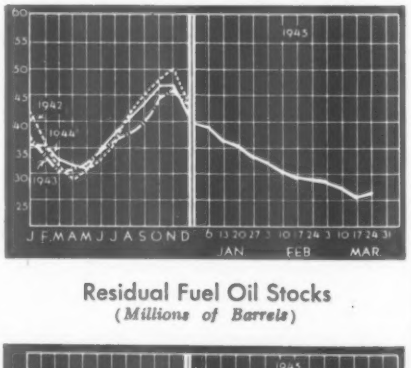
Gasoline Stocks

(Millions of Barrels)



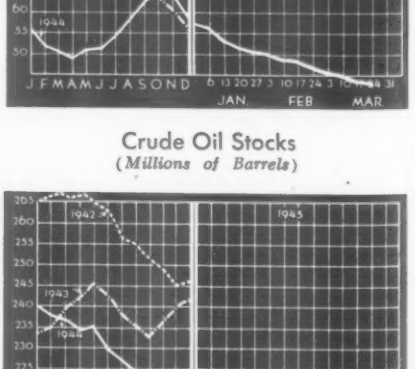
Gas Oil & Distillate Stocks

(Millions of Barrels)



Residual Fuel Oil Stocks

(Millions of Barrels)



Crude Oil Stocks

(Millions of Barrels)

OIL PRICE SECTION

★

At Refineries and Terminals and by Tank Wagon

Prices herewith are reproduced from **Platt's** *OILGRAM* Daily Oil Price Service, associated with National Petroleum News, whose representatives in all *NPN-OILGRAM* offices devote their time exclusively to reporting oil industry prices everywhere.

Prices shown are actual sales prices, or quotations meaning sellers' general offers or posted prices; for current sales and shipment; for the business day or period stated; except Tank Wagon prices, prices are for bulk lots such as tank car and motor transport; barge or tanker cargo lot prices are identified; FOB refineries or terminals; in cents per gal. except where shown in bbls. of 42 gals.; ex all fees and taxes; for crude oil and its products lawfully produced and transported; reported as received by *OILGRAM* and National Petroleum News but not guaranteed; for subscribers' private use only and not for resale or distribution or publication. For further details of price conditions apply to any *NPN-OILGRAM* office or see back of any *OILGRAM* Price Service invoice.

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Refinery Prices

Gasoline —U. S. Motor (A S T M) except where otherwise specified.

	Prices in Effect April 2	March 26
OKLAHOMA		
76 oct. Ethyl	6.75	6.75
70-74 oct.	5.875	5.875
63-66 oct.	5.625 (1)	5.625 (1)
60 oct. & below	5.25	5.25
MID-WESTERN (Group 3 basis)		
76 oct. Ethyl	6.75	6.75
70-74 oct.	5.875	5.875
63-66 oct.	5.625 (2)	5.625 (2)
60 oct. & below	5.2 – 5.25	5.2 – 5.25
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
76 oct. Ethyl	7	7
70-74 oct.	5.875	5.875
63-66 oct.	5.625 (1)	5.625 (1)
60 oct. & below	5.2 – 5.25	5.2 – 5.25
W. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
76 oct. Ethyl	7 (2)	7 (2)
70-74 oct.	5.875	5.875
63-66 oct.	5.625 (1)	5.625 (1)
60 oct. & below	5.25	5.25
CENT. W. TEX. (Prices to truck transports)		
76 oct.	7 (2)	7 (2)
70-74 oct.	5.875 (2)	5.875 (2)
67-69 oct.	....	....
62 oct. & below	5.25 (2)	5.25 (2)
KANSAS (For Kansas destinations only)		
76 oct. Ethyl	7.2 – 7.3	7.2 – 7.3
70-74 oct.	6.2	6.2
63-66 oct.	5.9 (2)	5.9 (2)
60 oct. & below	5.5	5.5
ARK. (For shipment to Ark. & La.)		
76 oct. Ethyl	7 (1)	7 (1)
70-74 oct.	5.875 (1)	5.875 (1)
62 oct.	....	....
60 oct. & below, unleaded	5.25 (1)	5.25 (1)
WESTERN PENNA. (Motor gasoline)		
Bradford-Warren:		
"Q" Gasoline Min. 70 Oct. (ASTM)	7.625-8.225(a)	7.625-8.225(a)
Other districts: "Q" Gasoline, Min. 70 Oct. (ASTM)	7.725	7.725

(a) Highs and lows for Schedule D area, in MPR 88 and outside Schedule D area, respectively.

Prices in Effect	April 2	March 26
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
U.S. Motor: (Oct. ASTM):		
70-74 oct.	7.875– 8.375	7.875– 8.375
75-76 oct.	9 (1)	9 (1)
Str. run gasoline, excluding Detroit shpt.	6	6
OHIO (S. O. Ohio quotations for statewide delivery and subject to exceptions for local price disturbances).		
70-74 oct.	8.25	8.25
CALIFORNIA U.S. Motor:		
76 oct. (Ethyl)	8 – 8.75	8 – 8.75
70-74 oct.	7 – 7.5	7 – 7.5
65 oct. & below (3rd grade)	5.75 – 6.25	5.75 – 6.25

Kerosine, & Gas Fuel Oils

OKLAHOMA		
41-43 grav. w.w.	4.375	4.375
42-44 grav. w.w.	4.5	4.5
Range oil	4	4
No. 1 p.w.	3.875	3.875
No. 1 straw	....	....
No. 2 straw	3.625	3.625
No. 3 fuel	3.5	3.5
No. 6 fuel	$0.90-$0.97	$0.90-$0.97
U. G. I. Gas Oil	....	....
14-16 fuel	$0.97 (1)	$0.97 (1)
MID-WESTERN (Group 3 basis)		
41-43 grav. w.w.	4.375	4.375
42-44 grav. w.w.	4.5	4.5
Range Oil	4 –4.1 (2)	4 –4.1 (2)
No. 1 p.w.	3.875	3.875
No. 2 straw	3.625	3.625
No. 3	....	....
No. 5	....	....
No. 6	$0.97 (1)	$0.97 (1)
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
41-43 grav. w.w.	4.375	4.375
42-44 grav. w.w.	4.5 (1)	4.5 (1)
No. 1 p.w.	3.875 (1)	3.875 (1)
No. 6 fuel	$0.97 (1)	$0.97 (1)
W. TEX.		
No 6 fuel	$0.97 (1)	$0.97 (1)
AMARILLO, TEX. (For shpt. to W. Okla. & Tex. differential territory.)		
42-44 grav. w.w.	4.5 (1)	4.5 (1)
KANSAS (For Kansas destinations only).		
41-43 grav. w.w.	No Price	No Price
42-44 grav. w.w.	4.7	4.7
No. 1 p.w.	4.1	4.1
No. 6 fuel	$0.95–$1.02	$0.95–$1.02
ARK. (For shipment to Ark. and La.)		
41-43 grav. w.w.	....	....
42-44 w.w. kero.	4.5 (1)	4.5 (1)
No. 1	....	....
No. 2	3.625 (1)	3.625 (1)
No. 3 fuel	3.5 (1)	3.5 (1)
Tractor fuel, for shpt. to Ark. points only	5.125 (1)	5.125 (1)
Diesel fuel 52 & below	4 (1)	4 (1)
Diesel fuel 58 & above	4.25 (1)	4.25 (1)
WESTERN PENNA. *Bradford-Warren:*		
45 grav. w.w.	6.5 – 7.55	6.5 – 7.55
46 grav. w.w.	....	....
No. 1 fuel	6.55-7.55(2&b)	6.55-7.55(2&b)
No. 2 "	6.125-7.125(2&b)	6.125-7.125(2&b)
No. 3 "	6.25-7.25(1&b)	6.25-7.25(1&b)
36-40 gravity	6.625-6.75(2)	6.625-6.75(2)

(b) Highs and lows for Schedule D area, in MPR 88 and outside Schedule D area, respectively.

Other districts:		
45 grav. w.w.	7 – 7.425	7 – 7.425
46 grav. w.w.	7.125– 7.375	7.125– 7.375
47 grav. w.w.	7.375– 7.50	7.375– 7.50
No. 1 fuel	6.875– 7.175	6.875– 7.175
No. 2 "	6.75 – 6.875	6.75 – 6.875
No. 3 "	6.75	6.75
36-40 grav. Pittsburgh dist. prices excluded	6.625– 6.875	6.625– 6.875
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
47-49 gravity w.w.	5.8 – 6	5.8 – 6
P.W. Distillate	5.5	5.5
No. 3 gas. oil, Straw	5	5
U.G.I gas oil	4.5 (2)	4.5 (2)
Fuel Oils (*Vis. at* 100).		
300-500 Vis.	4.14 (2)	4.14 (2)
100-300 Vis.	4.5	4.5
OHIO (S. O. quotations for statewide delivery)		
Kerosine	7	7

Prices in Effect	April 2	March 26
CALIFORNIA		
40-43 grav. w.w.	5 – 7	5 – 7
San Joaquin Valley:		
Heavy fuel	$1.10 (2)	$1.10 (2)
Light fuel	$1.20 (2)	$1.20 (2)
Diesel fuel	4 (2)	4 (2)
Stove dist.	5 (2)	5 (2)
Los Angeles:		
Heavy fuel	$1.10 (2)	$1.10 (2)
Light fuel	$1.20 (2)	$1.20 (2)
Diesel fuel	4 (2)	4 (2)
Stove dist.	5 (1)	5 (1)
San Francisco:		
Heavy fuel	$1.15 (1)	$1.15 (1)
Light fuel	$1.25 (1)	$1.25 (1)
Diesel fuel	4.5 (1)	4.5 (1)
Stove dist.	5.5 (1)	5.5 (1)

NOTE: All above heavy fuels meet Pacific specification 400; light fuel, spec. 300; Diesel fuels, spec. 200; and stove distillate, spec. 100.

Lubricating Oils

Prices in Effect	April 2	March 26
WESTERN PENNA. Prices are for sales made, or offers reliably reported, to jobbers & compounders only. **Viscous Neutrals**—*No. 3 col. Vis. at* 70°*F.*		
200 Vis. (180 at 100°) 420-425 fl.		
0 p.t.	38 (1)	38 (1)
10 p.t.	37 (1)	37 (1)
15 p.t.	36 (1)	36 (1)
25 p.t.	28-33	28-33
150 Vis. (143 at 100°) 400-405 fl.		
0 p.t.	36 (1)	36 (1)
10 p.t.	35 (1)	35 (1)
15 p.t.	34 (1)	34 (1)
25 p.t.	26-31	26-31

NOTE: Limited quantity neutrals available to regular trade.

Cylinder Stocks:

Brl. stk., 145-155 *vis. at* 210°, 540-550 fl., *No. 3 col.*		
10 p.t.	30.5 (1)	30.5 (1)
15 p.t.	29.5 (1)	29.5 (1)
25 p.t.	25	25
600 S.R. filterable	15	15
650 S.R.	15.5	15.5
600 fl.	16	16
630 fl.	17	17

MID-CONTINENT (F. o. b. Tulsa)

Neutral Oils (*Vis. at* 100° *F. to* 10 *P.P.*)

Pale Oils:

Vis. Color		
60-85—No. 2	7.5	7.5
86-110—No. 2	7.5 – 8.5	7.5 – 8.5
150—No. 3	11 –11.5	11 –11.5
180—No. 3	11.5 –15	11.5 –15
200—No. 3	12 –15	12 –15
250—No. 3	14 –16.5	14 –16.5
280—No. 3	15 –17	15 –17
300—No. 3	16 –18	16 –18

Red Oils:

180—No. 5	11.5 (1)	11.5 (1)
200—No. 5	12 (1)	12 (1)
280—No. 5	No Price	No Price
300—No. 5	16–17.5 (2)	16–17.5 (2)
Bright Stock—*Vis. at* 210°		
200 Vis. D	27 (1)	27 (1)
150-160 Vis. D: 0 to 10 p.p.	23	23
10 to 25 p.p.	22.5–23	22.5–23
25 to 40 p.p.	23 (1)	23 (1)
150-160 Vis. E	22 (1)	22 (1)
120 Vis. D: 0 to 10 p.p.	22 (2)	22 (2)
600 S.R. Dark Green	8.5 (1)	8.5 (1)
600 S.R. Olive Green	10-11 (2)	10-11 (2)
631 S.R.	....	....
Black Oil	....	....

NOTE: Discounts of 0.5c to 1c on bright stock and 0.5c to 2c allowed for neutrals, 10 car lots, and to "meet competition." Brokers offering at greater discounts.

SOUTH TEXAS (Neutral Oils)

Pale Oils (*Vis. at* 100°*F.*)

Vis. Color		
100 No. 1½-2½	6.5	6.5
200 No. 2-3	8.75	8.75
300 No. 2-3	9.25	9.25
500 No. 2½-3½	10	10
750 No. 3-4	10.25	10.25
1200 No. 3-4	10.375	10.375
2000 No. 4	10.5	10.5

(Continued on next page)

NOTE—Parenthetical figures after prices indicate number of companies quoting when less than three companies are quoting.

NOTICE—Owing to great demand, refiners generally limit quotations to regular customers and refuse bids, though higher, from others. Refiners' prices are sales shown; bids reported in market leads.

Refinery Prices (Continued)

Prices in Effect	April 2	March 26
Red Oils:		
100 No. 5-6	6.5 (2)	6.5 (2)
200 No. 5-6	8.75	8.75
300 No. 5-6	9.25	9.25
500 No. 5-6	10	10
750 No. 5-6	10.25	10.25
1200 No. 5-6	10.375	10.375
2000 No. 5.6	10.5	10.5

CHICAGO (From Mid-Continent p.l. crude.) Neutral *vis. at 100° F. to 10 p.p.*

Pale Oils		
Vis. Color		
60-85—No. 2	9 (1)	9 (1)
86-110—No. 2	9.25 (1)	9.25 (1)
150—No. 3	12.5 (1)	12.5 (1)
180—No. 3	13 (1)	13 (1)
200—No. 3	13 (1)	13 (1)
250—No. 3	14 (1)	14 (1)
Red Oils:		
180—No. 5	13 (1)	13 (1)
200—No. 5	13 (1)	13 (1)
250—No. 5	14 (1)	14 (1)
280—No. 5	15 (1)	15 (1)
300—No. 5	15.5 (1)	15.5 (1)

Note: Viscous oils, 15 to 30 p.p. are quoted 0.5c lower; 60-85 and 86-110 No. 2 non-viscous oils, 15 to 30 p.p., 0.25c lower.

Unfiltered Steam Refined (*Viscosity at 210°*)		
140	11.5 (1)	11.5 (1)
160	12.5 (1)	12.5 (1)
200	13.5 (1)	13.5 (1)
Bright stocks, 160 *vis. at 210 No. 8 color:*		
0 to 10 p.p.	24 (1)	24 (1)
15 to 25 p.p.	23.5 (1)	23.5 (1)
30 to 40 p.p.	21.5 (1)	21.5 (1)
E filtered Cyl. Stock	15.5 (1)	15.5 (1)

Note: To obtain prices delivered in Chicago add 0.25c per gal.

Natural Gasoline

(Group 3 & Breckenridge prices are to blenders on freight basis shown below. Shipments may originate in any Mid-Continent manufacturing district.)

FOB GROUP 3

Grade 26-70..... 4.75 (Sales) 4.75 (Quotes)

FOB BRECKENRIDGE

Grade 26-70..... 4.125 (Sales) 4.375 (Quotes)

CALIFORNIA (FOB plants in Los Angeles basin)

21 pound vapor pressure for blending.... 4.75 - 5.375 4.75 - 5.375

Naphtha and Solvent

(*FOB Group 3*)

Stoddard solvent	6.625	6.625
Cleaners' naphtha	7.125	7.125
V.M.&P. naphtha	7.1 - 7.125	7.1 - 7.125
Mineral spirits	6.1 - 6.125	6.1 - 6.125
Rubber solvent	7.1 - 7.125	7.1 - 7.125
Lacquer diluent	7.375- 8.125	7.375- 8.125
Benzol Diluent	7.875- 8.625	7.875- 8.625

WESTERN PENNA.

Other Districts:		
Untreated naphtha	7 -7.25 (2)	7 -7.25 (2)
Stoddard solvent	7.25 -7.5	7.25 -7.5 (2)

OHIO (S. O. quotations for statewide delivery:)

V.M.&P. naphtha.	D.C. naphtha,	Varnolene &
Sohio solvent	10	10
Rubber solvent	9	9

Wax

WESTERN PENNA. (Bbls. C.L.)

White Crude Scale:		
122-124 A.m.p.	4.25 (2)	4.25 (2)
124-126 A.m.p.	4.25	4.25

OKLAHOMA (C.L. FOB Refinery)

Semi-refined:		
128 AMP min., white, 50 kilo bags	No Price	No Price
132-134 AMP, bbls.	5.25 (1)	5.25 (1)

CHICAGO (FOB Chicago district refinery of one refiner, in bags, carloads. Carloads, slabs loose, 0.4c less. Melting points are EMP (ASTM) methods; add 3° to convert into AMP.)

Fully refined:		
122-124 (bags only)	5.6	5.6
125-127	6	6
127-129	6.25	6.25
130-132	6.55	6.55
132-134	6.8	6.8
135-137	7.55	7.55

Petrolatums

WESTERN PENNA. (Bbls., carloads; tank cars, 0.5c per lb. less.)

Snow White	6.125- 7.25	6.125- 7.25
Lily White	5.375- 6.25	5.375- 6.25
Cream White	4.375- 5.5	4.375- 5.5
Light Amber	3.375- 4	3.375- 4
Amber	3.125- 3.75	3.125- 3.75
Red	3 - 3.5	3 - 3.5

Tank Wagon Prices

Commercial or consumer tank car, tank wagon, dealer, and service station prices for gasoline **do not include taxes**; *they do, however, include inspection fees as shown in general footnote. Gasoline taxes, shown in separate column, include 1.5c federal, and state taxes; also city and county taxes as indicated in footnotes. Kerosine tank wagon prices also do not include taxes; kerosine taxes where levied are indicated in footnotes. Dealer discounts are shown in footnotes. These prices in effect April 2, 1945 as posted by principal marketing companies at their headquarters offices, but subject to later correction.*

S. O. N. J.

	Esso (*Regular Grade*) Consumer Tank Wagon	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
*Atlantic City, N. J.	10.2	10.7	4.5	10
*Newark, N. J.	10.2	10.7	4.5	10
Annapolis, Md.	10.55	11.05	5.5	....
Baltimore, Md.	9.95	10.45	5.5	10.8
Cumberland, Md.	11.35	11.85	5.5	12.3
Washington, D. C.	10.2	10.7	4.5	11.3
Danville, Va.	11.65	12.15	6.5	12.55
Norfolk, Va.	10.45	10.95	6.5	12.3
Petersburg, Va.	10.75	11.25	6.5	13.3
Richmond, Va.	10.75	11.25	6.5	13.3
Roanoke, Va.	11.95	12.45	6.5	12.8
Charleston, W. Va.	11.65	12.15	6.5	13.1
Parkersburg, W. Va.	10.95	11.45	6.5	12.8
Wheeling, W. Va.	10.95	11.45	6.5	13.4
Charlotte, N. C.	11.70	12.20	7.5	11.3
Hickory, N. C.	12.25	12.75	7.5	12.3
Mt. Airy, N. C.	12.10	12.6	7.5	11.5
Raleigh, N. C.	11.45	11.95	7.5	12.3
Salisbury, N. C.	11.75	12.25	7.5	12.7
Charleston, S. C.	10.55	11.05	7.5	....
Columbia, S. C.	11.40	11.9	7.5	....
Spartanburg, S. C.	12.1	12.6	7.5	....
New Orleans, La.	8.75	9.25	8.5	10.00
Baton Rouge	8.75	9.25	8.5	10.50
Alexandria	8.75	9.25	8.5	10.50
Lake Charles	9.00	9.50	8.5	12.00
Shreveport	8.50	9.00	8.5	9.00
Knoxville, Tenn.	10.50	11.00	8.5	12.50
Memphis	8.90	9.40	8.5	10.50
Chattanooga	10.50	11.00	8.5	11.00
Nashville	10.50	11.00	8.5	10.00
Bristol	10.95	11.45	8.5	13.10
Little Rock, Ark.	9.50	10.00	8.0	10.00

	Mineral Spirits T.W.	V.M.&P. T.W.
Newark, N. J.	13	14.5
Baltimore, Md.	15.5	....
Washington, D. C.	15.5	....

Fuel Oils—T.W.	No. 1	No. 2	No. 3
Atlantic City, N. J.	10	9	9
Newark	10	9	9
Annapolis, Md.	..	..	..
Baltimore	9.8	9	9
Washington, D. C.	10.3	9.4	9.4
Norfolk, Va	10	8.8	8.8
Petersburg	10.3	9	..
Richmond	10.3	9	9
Charlotte, N. C.	10.3	10.1	..
Hickory, N. C.	..	9.7	..
Raleigh	11.3	9.8	..
Charleston, S. C.	..	8.7	..
Columbia	..	9.7	..
Spartanburg	..	10.5	..

*Effective Aug. 5, '42 minimum retail resale price of 14.2c posted thru New Jersey. Discounts:

Esso gasoline—to undivided dealers, 0.5c off dealer t.w.

Kerosine—1c off t.w. price for 25 gals. or more, under contract thru territory (Baltimore city contract not necessary) except no discount in state of New Jersey.

Naphtha—To buyers taking following quantities at one time: Newark, 2c per gal. on 200 gals. or more, less than 200 gals. 0.5c higher price; Baltimore, 2c off on 25 to 100 gals. and 3c on over 100 gals.; Washington, 2c off to contract buyers.

Notice

These prices include inspection fees on both gasoline and kerosine unless otherwise specified per gallon as follows:

Ala. 1/40c on gasoline; Ark 1/20c; Fl. 1/8c; Ill. 3/100c; Ind. 1/5c in lots of 25 bbls. or less, 2/25c in lots of more than 25 bbls.; Kans. 1/50c; La. 1/32c; Minn. 7/200c; Miss. 1/50c; Neb. 3/100c; Nev. 1/20c; N. C. 1/4c; N. Da. 1/20c; Okla. 2/25c; S. Car. 1/8c; S. Da. 1/20c; Tenn. 2/5c; and Wisc. 3/100c.

Kerosine inspection fees only: Ala. 1/2c; Fla. 1/8c; Iowa 3/50c; Mich. 1/5c per gal.

CONT'L OIL

	Conoco Bronz-z-z (*3rd Grade*) †Tank Wagon	Demand	Gasoline Taxes	Kerosine T.W.
Denver, Col.	10	9	5.5	10
Grand Junc., Col.	12.5	11.5	5.5	12.5
Pueblo, Col.	9.5	8.5	5.5	9.5
Casper, Wyo.	11.5	10.5	5.5	12
Cheyenne, Wyo.	10	9	5.5	9
Billings, Mont.	12	11	6.5	12.5
Butte, Mont.	11.5	10.5	6.5	13.5
Great Falls, Mont.	12	11	6.5	12.5
Helena, Mont.	12	11	6.5	13
Salt Lake City, Utah	13.5	12.5	5.5	14.5
Boise, Ida.	14.5	13.5	7.5	16.5
Twin Falls, Ida.	15.5	14.5	7.5	17
Albuquerque, N. M.	10.5	9.5	*7	9.5
Roswell, N. M.	10	9	*7	7
Santa Fe, N. M.	10.5	9.5	*7.5	10
Ft. Smith, Ark.	9	6.25	*7	8
Texarkana, Ark.	9	7.5	*5.5	7
Muskogee, Okla.	7.75	6.75	7	8
Oklahoma City, Okla.	8	7	7	8
Tulsa, Okla.	8	7	7	8

*Taxes: In gasoline tax column are included these city taxes—Albuquerque, & Roswell, 0.5c; Santa Fe, 1c. Texas 4c state tax applies within city limits of Texarkana, Ark.; Okla., 5.5c state applies within city limits of Ft. Smith, Ark.

†To consumers & Dealers.

NOTE: Current selling price—where this is lower than maximum price it is because of local competition. It is the actual selling price and is subject to revision due to delays in receiving information from the field.

S. O. CAL.

	Standard Posted Net Tank Truck	Standard Retail	Flight Posted Net Tank Truck	Flight Retail	Gasoline Taxes
	Standard Gasoline (*Regular Grade*) Flight Gasoline (*Third Grade*)				
San Francisco, Cal.	10	14	9	12	4.5
Los Angeles, Cal.	9.5	13.5	8.5	11.5	4.5
Fresno, Cal	11	15	10	13	4.5
Phoenix, Ariz.	12	16	10	13	6.5
Reno, Nev.	12	16	11	14	5.5
Portland, Ore.	10.5	14.5	9.5	12.5	6.5
Seattle, Wash.	10.5	14.5	9.5	12.5	6.5
Spokane, Wash.	12.5	16.5	11.5	14.5	6.5
Tacoma, Wash.	10.5	14.5	9.5	12.5	6.5

*Chevron Aviation 73

	Posted Net Tank Truck	Gasoline Taxes	Kerosine Tank Truck
San Francisco, Cal.	12.5	4.5	11.5
Los Angeles, Cal.	12	4.5	10
Fresno, Cal.	13.5	4.5	12.5
Phoenix, Ariz.	14.5	6.5	12.5
Reno, Nev.	14.5	5.5	13.5
Portland, Ore.	13	6.5	13.8
Seattle, Wash.	13	6.5	13.8
Spokane, Wash.	16	6.5	16.8
Tacoma, Wash.	13	6.5	13.8

Resale and Commercial Gasoline: Tank car deliveries of Standard Aviation 73, Standard's Supreme and Flight Gasoline .25c per gal. below posted net tank truck price. Tank car deliveries of Standard Gasoline .375c per gal. below posted net tank truck price. Pearl Oil (The Standard Kerosene) Tank car deliveries 3c below posted tank truck price.

*Formerly Standard Aviation 73.

TEXAS CO.

	Gasoline—Dealer T.W. Fire-Chief (Regular)	Indian (*3rd Grade*)	Gasoline Taxes
Dallas, Tex.	7.5	6.5	5.5
Ft. Worth, Tex.	7.5	6.5	5.5
Wichita Falls, Tex.	8.5	7.5	5.5
Amarillo, Tex.	8.5	7.5	5.5
Tyler, Tex.	8.5	7.5	5.5
El Paso, Tex.	11	10.5	5.5
San Angelo, Tex.	8.5	7.5	5.5
Waco, Tex.	8.5*	7*	5.5
Austin, Tex.	8.5	7.5	5.5
Houston, Tex.	8.5	7.5	5.5
San Antonio, Tex.	8.5	7.5	5.5
Port Arthur, Tex.	8.5	7.5	5.5

*Less 1c temporary allowance to all dealers.

(Continued on next page)

Tank Wagon Prices—Continued

S. O. IND.

	Red Crown Blue Crown Red Dealer Prices (*Regular Grade*) Crown Cons. T.W.	Red Crown (*Third Grade*) T.W.	Blue Crown T.W.	Gasoline Taxes	Kerosine T.W.
Chicago, Ill.	11.6	9.6	9.1	4.5	10.6
Decatur, Ill.	11.6	9.6	8.7	4.5	10.3
Joliet, Ill.	11.9	10.3	9.2	4.5	10.6
Peoria, Ill.	11.7	9.9	9.7	4.5	10.4
Indianapolis, Ind.	11.6	10.1	9.6	5.5	10.1
Evansville, Ind.	11.4	9.9	8.6	5.5	9.9
South Bend, Ind.	12	10.5	10	5.5	10.5
Detroit, Mich.	11.4	9.9	...	4.5	10
Grand Rapids, Mich.	11.4	9.9	...	4.5	9.9
Saginaw, Mich.	11.4	9.9	...	4.5	9.9
Green Bay, Wis.	12.2	10.7	10.2	5.5	10.9
Milwaukee, Wis.	12.1	10.6	10.1	5.5	10.8
La Crosse, Wis.	11.9	10.4	9.9	5.5	10.6
Minneapolis - St. Paul	11.9	10.4	9.9	5.5	10.6
Duluth, Minn.	12.2	10.7	10.2	5.5	10.9
Mankato, Minn.	11.9	10.4	9.9	5.5	10.6
Des Moines, Ia.	11.4	9.9	9.4	4.5	*10.1
Mason City, Ia.	11.7	10.2	9.7	4.5	*10.4
St. Louis, Mo.	11.0	9.5	9.3	*4.5	10.1
Kansas City, Mo.	11.0	9.5	8.6	*4.5	9.7
St. Joseph, Mo.	11.2	9.7	9.2	*4.5	9.9
Fargo, N. D.	12.9	11.4	10.9	5.5	11.6
Huron, S. D.	12.3	10.8	10.3	5.5	11
Wichita, Kans.	10.3	8.8	7.2	4.5	9.0
Omaha, Neb.	11.4	9.6	9.4	6.5	10.1

	Oleum Spirits	V.M.&P. Naphtha	Stanisol	*Taxes
(Prices are base prices before discounts)				
Chicago	13.5	13.8	12.8	4.5
Detroit	15.8	15	16.3	4.5
K. C., Mo.	13.3	14.3	13.8	1.5
St. Louis, Mo.	13.7	14.7	13.2	1.5
Milwaukee	14.4	15.4	14.9	5.5
Minneap'ls	14.2	15.2	13.5	5.5

Fuel Oils T.W. Chicago	Standard Heater Oil	Stanolex Furnace Oil
1-99 gals.	9.3	8.8
100-149 gals.	8.3	7.8
150 gals. & over	7.8	...
150-399 gals.	...	7.8
400 gals. & over	...	7.3

	Stanolex Fuel A	Stanolex Fuel C
1-749 gals.	6.5	6.0
750 gals. & over	5.75	5.25

Stanolex Furnace Oil Other Points	1-99 gals.	100 gals. & over
Indianapolis	9.0	8.0
Detroit	8.7	7.7
Milwaukee	9.0	8.0
Minneapolis	9.1	8.1
St. Louis	8.4	7.4
Kansas City	8.1	7.1

*Taxes: In gasoline tax column are included these city taxes—Kansas City, St. Joseph and St. Louis, 1c. Iowa kerosine prices are ex 3c state tax. In naphtha tax column are included 1.5c federal tax and state taxes.

State sales, occupation, consumer and use taxes to be added when applicable.

S. O. OHIO

	*Sohio X-70 Gasoline (*Regular Grade*) Consumer T.W.	**Reselers	‡S.S. Taxes	Gasoline Taxes	†Kerosine T.W.
Ohio, Statewide	12	10	13.5	5.5	9.3
Akron	12	9.5	12.5	5.5	9.3
Canton	12	9.5	12.5	5.5	9.3
Cincinnati	12	9.5	12.5	5.5	9.3
Cleveland	12	9.5	12.5	5.5	9.3
Columbus	12	9.5	12.5	5.5	9.3
Dayton	12	9.5	12.5	5.5	9.3
Lima	12	9.5	12.5	5.5	9.3
Mansfield	12	9.5	12.5	5.5	9.3
Marion	12	9.0	12.0	5.5	9.3
Portsmouth	12	9.5	12.5	5.5	9.3
Toledo	12	9.5	12.5	5.5	9.3
Youngstown	12	9.5	12.5	5.5	9.3
Zanesville	12	9.5	12.5	5.5	9.3

Aviation Gasoline—Statewide

	Consumer Gasoline T.W.	Taxes
Sohio Aviation Gasoline clear Spec. AN-F-22	14.5	5.5
Esso Ethyl Aviation 73 Oct.	15.5	5.5
Esso Ethyl Aviation 80 Oct.	16.5	5.5
Esso Ethyl Aviation 91 Oct.	17.5	5.5
Esso Ethyl Aviation 100 Oct.	24.5	5.5

	Naphtha—T.W. Statewide	Lucas County
S. R. Solvent	13.5	13.5
D. C. Naphtha	14.5	14.25
V.M.&P. Naphtha	14.5	14.25
Varnolene	14.5	14.25
Sohio Solvent	14.5	14.25

Fuel Oils—T.W.	No. 1	No. 2	No. 3	No. 4
Ohio, Statewide	8.3	8.3	7.8	*7.55

*Renown (third-grade) prices are same as X-70 unless otherwise noted.

**Except authorized agents.

‡Prices at company-operated stations.

††Statewide prices are subject to exceptions other than those shown.

Discounts:

Esso aviation—on contract to hangar operators and resellers, 2c off consumer t.w.

*For Cleveland area only. Full compartment hose dumps.

Fuel oils—Statewide prices are for t.w. & drum deliveries of 50 gals. or more; prices for deliveries of less than 50 gals. are 0.5c higher.

Naphthas—to contract consumers off t.w. prices—Statewide: 300 to 999 gals., 0.5c; 1000 to 2499 gals., 0.75c; 2500 to 4999 gals., 1c; 5000 or more gals., 1.5c. Lucas County: Less than 50 gals., tank wagon price, 50 to 249 gals., 0.5c; 250 to 499 gals., 1c; 500 gals. or over, 1.5c.

ATLANTIC REFINING

Atlantic White Flash (*Regular Grade*)

	Commercial T.W.	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
Philadelphia, Pa.	10.2	10.7	5.5	12.25
Pittsburgh	10.1	10.6	5.5	12.1
Allentown	10.7	11.2	5.5	12.6
Erie	10.1	10.6	5.5	12.1
Scranton	10.7	11.2	5.5	12.6
Altoona	10.7	11.2	5.5	12.6
Emporium	10.1	10.6	5.5	12.1
Indiana	10.7	11.2	5.5	12.6
Uniontown	10.1	10.6	5.5	12.1
Harrisburg	10.7	11.2	5.5	12.6
Williamsport	10.7	11.2	5.5	12.6
Dover, Del.	....	11.2	5.5	12.6
Wilmington, Del.	....	10.7	5.5	12.1
Boston, Mass.	....	10.9	4.5	....
Springfield, Mass.	....	11.8	4.5	....
Worcester, Mass.	....	11.5	4.5	....
Fall River, Mass.	....	11	4.5	....
Hartford, Conn.	....	11.6	4.5	....
New Haven, Conn.	....	11	4.5	....
Providence, R. I.	....	11	4.5	....
Atlantic City, N. J.	....	10.7	4.5	10
Camden, N. J.	....	10.7	4.5	10
Trenton, N. J.	....	10.7	4.5	10
Annapolis, Md.	....	11.05	5.5	10.8
Baltimore, Md.	....	10.45	5.5	9.8
Hagerstown, Md.	....	11.55	5.5	10.3
Richmond, Va.	....	11.25	6.5	12.3
Wilmington, N. C.	....	11.15	7.5	11.6
Brunswick, Ga.	....	10.1	7.5	10.6
Jacksonville, Fla.	....	10.1	8.5	11.6

	Mineral Spirits T.W.†	V.M.&P. T.W.†
Philadelphia, Pa.	11	12.5
Lancaster, Pa.	12	13.5
Pittsburgh, Pa.	12.5	13.5

	Fuel Oils—T.W. 1	2	3	5	6
Phila., Pa.	10.1	9	9	5.76	5.04
Allentown, Pa.	10.6	9.3	9.3	....	....
Wilmington, Del.	10.1	9	9	....	....
Springfield, Mass.	10.2	9.4	9.4	....	....
Worcester, Mass.	10.2	9.3	9.3	....	....
Hartford, Conn.	10.5	9.2	9.2	....	....

‡Does not include 1c Georgia kerosine tax.

†Mineral Spirits prices also apply to Stoddard Solvent; V.M.&P. prices also apply to Light Cleaners Naphtha.

Discounts:

Gasoline—to undivided dealers, 0.5c off dealer t.w. except Georgia & Florida dealer t.w. and undivided dealer t.w. prices are same.

Kerosine—Thru Penna. & Delaware, 2c off t.w. price on t.w. deliveries of 25 gals. or more at one time.

S. O. KY.

Crown Gasoline (*Regular*) Standard (*Third Grade*)

	†Net Crown	Gasoline Taxes	Kerosine T.W.
Covington, Ky.	9.5	6.5	9.3
Lexington, Ky.	10.5	6.5	9.3
Louisville, Ky.	10	6.5	8.8
Paducah, Ky.	10	6.5	8.8
Jackson, Miss.	10	7.5	*9
Vicksburg, Miss.	9.5	7.5	*8.5
Birmingham, Ala.	10	*8.5	9
Mobile, Ala.	9	*9.5	8.5
Montgomery, Ala.	10	*9.5	*10
Atlanta, Ga.	11.1	7.5	*11.6
Augusta, Ga.	11.1	7.5	*11.1
Macon, Ga.	11.1	7.5	*11.6
Savannah, Ga.	10.1	7.5	*10.6
Jacksonville, Fla.	10.1	8.5	9.6
Miami, Fla.	10.1	8.5	9.6
Pensacola, Fla.	9	*9.5	8
Tampa, Fla.	10.1	8.5	9.6

*Taxes: In tax column are included these city and county gasoline taxes: Mobile, 2c city; Birmingham, 1c city, Montgomery, 1c city and 1c county; Pensacola, 1c city. Georgia and Montgomery, Ala. have 1c kerosine tax, Mississippi 0.5c, included in above prices.

†Consumer t.w. prices are same as net dealer prices.

HUMBLE OIL

Humble Motor Fuel (*Regular Grade*)

	Thriftane Humble *Tank Wagon	Thriftane Humble Retail	*Third Grade* Thriftane *Tank Wagon	Thriftane Retail	Gasoline Taxes
Dallas, Tex.	7.5	10.5	6.5	10.5	5.5
Ft. Worth, Tex.	6.5	9.5	6	7.5	5.5
Houston, Tex.	8.5	12.5	7.5	10.5	5.5
San Ant., Tex.	8.5	12.5	7.5	10.5	5.5

Consumer tank wagon prices are 1c per gal. above the dealer tank wagon prices at Dallas and Ft. Worth.

	Kerosine *Tank Wagon	Kerosine Retail
Dallas, Tex.	7	10
Ft. Worth, Tex.	7	11
Houston, Tex.	8	11
San Antonio, Tex.	7	10

*To all classes of dealers & consumers.

Canada

PRICES OF IMPERIAL OIL, LTD.

Per Imperial Gallon, which is 1.2 U. S. Gallons

IMPERIAL OIL

3-Star Imperial Gasoline (*Regular Grade*)

	†Gasoline T.W.	*Gasoline Taxes	Kerosine T.W.
Hamilton, Ont.	16.5	11	18
Toronto, Ont.	16.5	11	18
Brandon, Man.	20.5	10	23
Winnipeg, Man.	20.0	10	22.5
Regina, Sask.	17.5	10	20
Saskatoon, Sask.	20.3	10	22.8
Edmonton, Alta.	18.4	10	20.9
Calgary, Alta.	15.5	10	18
Vancouver, B. C.	15	10	24
Montreal, Que.	16.5	11	17.5
St. John, N. B.	16	13	19
Halifax, N. S.	16	13	19

*Includes 3c Federal, and Provincial taxes.

†To divided & undivided dealers.

Absorption Gasoline—No. 26 R.V.P.—$2.28.

Gasoline prices effective Oct. 7.

SOCONY VACUUM

	Socony Mobilgas (*Regular Grade*) Com. Cons. T.W.	Undiv. Dlr. T.W.	Gasoline Taxes
New York City			
Manhattan & Bronx	10.1	10.6	*5.5
Kings & Queens	10.1	10.6	*5.5
Richmond	9.7	10.2	*5.5
Albany, N. Y.	9.9	10.4	5.5
Binghamton, N. Y.	11	11.5	5.5
Buffalo	9.6	10.1	5.5
Jamestown, N. Y.	9.8	10.3	5.5
Mt. Vernon, N. Y.	10.1	10.6	5.5
Plattsburg, N. Y.	11	11.5	5.5
Rochester, N. Y.	10.8	11.3	5.5
Syracuse, N. Y.	10.5	11	5.5
Bridgeport, Conn.	10	10.5	4.5
Danbury, Conn.	10.5	11	4.5
Hartford, Conn.	10.6	11.1	4.5
New Haven, Conn.	10	10.5	4.5
Bangor, Me.	10.7	11.2	5.5
Portland, Me.	10.3	10.8	5.5
Boston, Mass.	9.9	10.4	4.5
Concord, N. H.	11.4	11.9	5.5
Lancaster, N. H.	12	12.5	5.5
Manchester, N. H.	11.3	11.8	5.5
Providence, R. I.	10	10.5	4.5
Burlington, Vt.	10.9	11.4	5.5
Rutland, Vt.	11	11.5	5.5

(Continued on next page)

Seaboard Export Coastwise Prices

Atlantic Coast

(Prices are of refiners, FOB their refineries & their tanker terminals, & of tanker terminal operators FOB their terminals)—Prices in Effect April 2.

MOTOR GASOLINE

District	72 Oct. (ASTM)	70-74 oct. (ASTM)	KEROSINE and/or NO. 1 FUEL
N. Y. Harb.	Not made	9.075	7.1
N. Y. Harb., barges	"	8.5 – 8.975	7
Albany	"	9.175	7.3
Philadelphia	"	9.075	7.2
Baltimore	"	8.825	7.2
Norfolk	"	8.575	7.1
Wilmington, N. C.	"	8.175	6.75
Charleston	"	8.175	6.9
Savannah	"	7.845	6.55
Jacksonville	"	7.845	6.55
Miami	"	7.845	6.55
Tampa	"	7.845	6.55
Pensacola	"	6.875 (1)	4.8 (1)
Mobile	"	6.62 – 6.745	4.75 (2)
New Orleans	"	6.125 (1)	4.125–4.25 (2)
Portland	"	9.375	7.3
Boston	"	9.275	7.2
Providence	"	9.275	7.2

(a) Price is for straight-run low pour, test No. 5 ($1.95)

Pacific Export

In Ship's Bunkers, or deep tank lots:

Prices in Effect	April 2	March 26
Diesel Fuel, Pac. Spec. 200	$1.45	$1.45
Grade C fuel, Pac. Spec. 400	$1.10	$1.10

FUEL OILS

	No. 2	No. 3	No. 5	No. 6
New Haven	6.7	6.7	$1.85–$1.95(a)	$1.77
N. Y. Harbor	6.6	6.6 (2)	....	....
Albany	6.8	6.8 (2)	....	$1.97 (1)
Philadelphia	6.7	6.7	$1.98	$1.77
Baltimore	6.7	6.7	$1.85 (1)	$1.77
Norfolk	6.7	6.7 (1)	$1.85 (1)	$1.77
Charleston	6.4	....	....	....
Savannah	6.4 (2)	....	$1.80 (1)	$1.72 (2)
Jacksonville	5.75 (1)	....	....	$1.72 (1)
Tampa	5.75	....	....	$1.72
New Orleans	5.75 (1)	....	....	....
Portland	5.75	....	....	$1.62
Boston	....	....	....	....
Providence	....	....	....	....
	3.75 (2)	....	$1.05–1.25(1*)	$0.97
	6.8	6.8 (2)	....	$1.77
	6.7	6.7 (2)	$1.95 (2)	$1.77
	6.7	6.7 (2)	$1.90 (1)	$1.77

Tank Wagon Prices (Continued)

	Mineral Spirits T.W.	V.M.&P. T.W.
Buffalo, N. Y.	12 4	13.6
New York City	11	12
Rochester, N. Y.	13 2	14.4
Syracuse, N. Y.	14	....
Boston, Mass.	12	13
Bridgeport, Conn.	†16 3	†17.3
Hartford, Conn.	†16.3	†17.3
Providence, R. I.	13	14

	Kerosine Yard	Kerosine T.W.	Mobilfuel Diesel T.C.	Mobilfuel Diesel T.W.	Mobilheat Fuel Yard	Mobilheat Fuel T.W.
New York:						
Manhat'n & Bronx	7.5	10.3	...	9.3	7.1	9
Kings & Queens	7.5	10.3	...	9.3	7.1	9
Richmond	7.5	10.3	...	...	7.1	9.0
Albany	7.5	9.8	6.8	9.3	7	9
Binghamton	8.9	11.2	...	10.7	8.4	10.2
Buffalo	8.1	10.4	7.5	9.8	7.7	9.5
Jamestown	8.2	10.5	...	10.1	7.8	9.5
Mt. Vernon	7.6	10.3	...	9.4	7.2	9
Plattsburg	8.1	10.4	...	9.9	7.6	9.4
Rochester	8.7	11	7.9	10.2	7.9	9.7
Syracuse	8.5	10.8	7.8	10.1	7.8	9.6
Conn.:						
Bridgeport	7.8	10.3	...	....	7.3	9.0
Danbury	8.2	10.8	...	....	7.8	8.5
Hartford	8.0	10.5	...	9.5	7.4	9.2
New Haven	7.5	10.3	...	9.3	7.1	9.0
Maine:						
Bangor	7.9	10.2	7.4	9.7	7.4	9.1
Portland	7.5	10.2	6.8	9.3	7	9
Mass.:						
Boston	7.8	10.6	6.7	9.2	7.1	9
N. H.:						
Concord	8.4	10.7	...	...	8.2	10
Lancaster	9.5	11.8	...	....	9.2	11
Manchester	8.5	11.1	...	....	7.9	9.7
R. I.:						
Providence	7.8	10.1	6.7	9.2	7.1	9.0
Vermont:						
Burlington	8.1	10.4	7.5	9.8	7.5	9.2
Rutland	8.3	10.6	...	10	7.7	9.5

*Does not include 1% city sales tax applicable to price of gasoline (ex tax).
†In steel barrels
Discounts: Diesel—On t.w. deliveries, 0.5c for at least 400 gals.; 1c for full tank truck.

EXPORT PRICES

Prices Effective April 2

	Mexican Gulf Ports U. S. Dollars per Bbl. Bunker C	Diesel
Tampico	$0.97	$1.65
Veracruz	0.97	....
Coatzacoalcos	0.97	1.65
	Pacific Coast	
Guaymas	$1.50	$3.22
Mazatlan	1.50	3.22
Acapulco	1.50	2.89
Manzanillo	1.50	2.89
Salina Cruz	1.50	2.89

	Bunker C Fuel Ships' bunkers (Ex Lighterage)	Diesel Oil Ships' bunkers (Ex Lighterage)	Diesel Oil Shore Plants	Gas House Gas Oil 28-34 Gravity
New Haven	$1.77	....	....	....
N. Y. Harbor	$1.77	$2.78	6.7	6.8 (2)
Albany	$1.97 (1)	$2.94 (1)	6.8 (1)	7 (1)
Philadelphia	$1.77	$2.78	....	....
Baltimore	$1.77	$2.78	6.7 (1)	6.7 (1)
Norfolk	$1.77	$2.78	6.7 (1)	6.7 (1)
Charleston	$1.72 (2)	$2.65 (2)	6.4 (1)	6.4 (1)
Savannah	$1.72 (1)	$2.52 (1)	....	....
Jacksonville	$1.72 (2)	$2.41 (2)	....	....
Tampa	$1.62	$2.41 (2)	....	....
New Orleans	$0.97	$1.65 (1)	4 (1)	....
Portland	$1.77	....	6.8 (1)	6.9 (1)
Boston	$1.77	$2.78 (2)	6.7 (2)	6.8 (2)
Providence	$1.77	$2.78 (2)	6.7 (1)	6.8 (1)

Bunker "C" when from Navy storage at New York and Norfolk to out-going vessels ships .05c discount. (Subject to cancellation.)
*—$1.05 semi-refined; 1.25—100% distillate.

Gulf Coast

Prices in Effect April 2

MOTOR GASOLINE	New Orleans & Lower Mississippi to Baton Rouge Tank Cars	New Orleans & Lower Mississippi to Baton Rouge Barges	Texas Gulf Coast South of New Orleans Tank Cars	Texas Gulf Coast South of New Orleans Barges	CARGOES Domestic & Export From all Gulf Ports
Leaded (oct. by ASTM)					
76 oct.	6.75	6.5	6.75	6.75	6.75
70-74 oct.	6 – 6.125	5.625	5.625–6.375 (a)	5.625	5.625
63-65 oct.	....	....	....	....	....
Unleaded 70 oct.	....	....	....	....	5.625
67-68 oct.	....	....	....	....	....
65 oct.	....	....	....	....	5.25
60 oct.	....	....	....	....	5
KEROSINE & LIGHT FUELS					
41-43 w.w. kero.	4.125– 4.25	4.125	4.125– 4.25	4.125	4.125
42-44 w.w. kero.	....	....	4.125	4.125	4.125
No. 2 fuel oil.	3.75	3.75	3.75 – 4	3.75	3.75
DIESEL & GAS OILS					
(In diesel index No.)					
Below 43 di.	....	....	....	....	....
43-47 di.	....	....	....	....	4
48-52 di.	4	4	4	....	4
53-57 di.	4.125	....	4.125	4.125	4.125
58 and above	4.25	....	4.25	....	4.25

(a) 5.625c for Dist. 1 and 6.125-6.375c for other districts.
NOTE: Above products in Truck Transports of 2,400 gal. and over ½c above Tank Car Prices.

Heavy Fuels & Bunker Oil (at all Gulf Ports) Heavy Diesels	In Cargoes	In Ship's Bunkers (Ex Lighterage)
Below 28 API Grav.	....	$1.35
28 & above API Grav.	....	$1.65
Bunker C Oil	$0.97	$0.97

Mid-Continent Lubes

(At Gulf; in packages, FAS.; in bulk, FOB terminals).

Prices in Effect April 2

	Steel Drums	Bulk
Bright Stock		
D color, Vis at 210°		
200 vis.	....	....
150 vis., 0-10 p.p.	32.65 (1&a)	24.8 (1)
100 vis., 0-10 p.p.	....	....
100 vis., 10-25 p.p.	....	....
Neutral—No. 3 color		
200 vis., 0-10 p.p.	....	....

(A) FAS at New Orleans.

Wax

(Melting points are AMP, 3° higher than EMP) Prices are FOB refinery and do not include bag; freight or export differentials).

Prices in Effect April 2

Crude Scale	New Orleans Export	N. Y. Domestic	N. Y. Export
124-6 Yellow	4.25 (1)	....	4.25 (1)
122-4 White	....	4.25 (2)	4.25 (2)
124-6 White	4.25 (1)	4.25	4.25
Fully Refined:			
123-5	5.2 (1)	5.2 (2)	5.2 (1)
125-7	5.2 (1)	5.2 (2)	5.2 (1)
128-30	5.6 (1)	5.6	5.6 (1)
130-32	5.85 (1)	5.85 (2)	5.85 (1)
133-5	6.15 (1)	6.15	6.15 (1)
135-7	6.4 (1)	6.4 (1)	6.4 (1)

Naphtha

Prices in Effect April 2

	V.M.&P. Naphtha	Mineral Spirits
New York Harbor	11 (2)	10
Philadelphia	11 (2)	10
Baltimore	10.5 (2)	9.5
Boston	11.5 (2)	10.5
Providence	11.5 (1)	10.5 (2)

CLASSIFIED

For Sale

FOR SALE: Bowser Exacto, gasoline driven pump and meter for tank truck. Write—H. A. Schmehl, Chagrin Falls, Ohio.

3615 GALLON PROGRESS 3-compartment Tank, with meter, very low mileage and new 10:00 x 20 tires. Also Ford tractor—fully equipped—like new. Speedway Oil Company, Anderson, Indiana.

FOR SALE: G.M.C. 4 (Dual) Wheel Trailer with 1500 gallon 5-compartment Tank. Two inch lines, Brodie meter, 900 x 20 tires, air brakes. Condition good. Price $1150.00. Box No. 567.

FOR SALE: Fruehauf 4 (Dual) Wheel Trailer with 2500 gallon 3-compartment Tank. Three inch lines—975 x 20 tires. Air brakes. Condition very good. Price $1450.00. Box No. 568.

AVAILABLE 600 cases bottled Motor Oil packed 20/1 quart bottles to case. All grades SAE No. 10-20-30-40. Attractive labeled package. Carload or LCL 45c per gallon, tax paid, F.O.B. Detroit, Mich. Box No. 566.

FOR SALE: Fruehauf 40-Model 3-compartment 3545 gal. Semi-Trailer. 38-D-40 Int. Tractor—K7 Motor—5 Speed Trans. Will sell as complete unit or separate, well below ceiling; running every day. John Dailey, Box 295, Moss Point, Miss. Phone 5111.

For Sale

MICHIGAN GEOLOGICAL SURVEY

Nine Volumes and Atlas—Out of Print

Complete Set Rare—Good Condition

F. E. McCain

522 Hammond Bldg., Detroit 26, Mich.

Business Opportunities

AVAILABLE NOW—Limited number of attractive jobber franchises in New Mexico and Arizona. Southwestern refinery now in position to negotiate excellent contracts with responsible individuals. Write us in confidence, telling us about yourself, including mention of present occupation, personal and financial references. Malco Refineries, Inc., Artesia, New Mexico.

OPPORTUNITY FOR OIL COMPANY

interested in marketing petroleum and its products in Egypt and Palestine.

Facilities include one bulk plant containing one tank of 1,120,000 gals. capacity, one tank of 350,000 gals. capacity and one tank of 35,000 gals. capacity with ample room for expansion. Also two 6″ lines leading to dock for loading and unloading tankers and barges; railroad siding for loading and unloading tankcars.

Will consider agency for above mentioned territory to market supplier's brand or will purchase material and pay cash—price to be agreed upon. If above not possible, will lease premises to company desiring own marketing setup. If none of the above can be negotiated, then would be willing to sell premises. Box No. 569

Positions Wanted

REFINERY ENGINEER, 20 years foreign and domestic experience in construction, purchase, operation, instrumentation and materials, offers services to concern looking for reliable, experienced engineer for foreign work. Box No. 550.

LUBRICATION ENGINEER, 30 years' experience, automotive and industrial products, presently employed, desires connection with small but promising oil company. Location: eastern seaboard. Box No. 570.

AGGRESSIVE PETROLEUM MERCHANDISER with twenty years' successful background in Management and Development Sales—Service—Training Programs—Bulk Plant—Super Service Stations—Jobber and Dealer Market, as well as chain station Marketing, desires association with company contemplating Strong Post War Program. Capable assuming full responsibility—married—age 44. Negotiations treated in confidence. Box No. 571

DISTRICT SALES MANAGER

Large Personal Producer with sixteen years marketing experience, selling carload and tank-car lots of 100% Pennsylvania Oil to refiners, jobbers and distributors in mid-western and Southwestern territory. Wish to represent Refiner who wants substantial distribution.

Box No. 564

Situations Open

WANTED SALES MANAGER

For large independent distributor in metropolitan New Jersey territory. Must be aggressive with experienced background preferably in the East. Good salary for right party. Applicants state full details together with age. Reply—

Box No. 565

TANK CAR SALESMAN

Excellent opportunity with a major company for experienced Tank Car Salesman. Reply stating experience, age, education, and salary expected. Reply to—

Box No. 554

MEN FOR FOREIGN EMPLOYMENT

In Saudi Arabia

Refinery operators; petroleum, electrical and mechanical engineers; radio operators and technicians; air-conditioning and refrigeration mechanics; stabilizer operators; welders (pressure-vessel-pipeline); stenographers; typists.

Employment offers opportunities for post-war security and advancement. Liberal benefit plans; vacations in United States; free hospital and medical care.

If genuinely interested in foreign career, send full information on experience, transcript of college record (Professional applicants only), references, draft and availability status to our Employee Relations Department.

ARABIAN AMERICAN OIL COMPANY

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Wanted to Buy

WILL BUY DISTRIBUTORSHIP

Will purchase distributorship for gasoline and oil products in Western Pennsylvania or Western New York. Will be especially interested in Northwestern Pennsylvania or Southwestern New York.

Box No. 563

WANTED TO BUY

Steel Storage Tanks 3,000 to 20,000 gallon capacity. Rotary Pumps.

Empire Equipment Corporation

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Phone: Main 7667

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Available for consultation on OPA Price Regulations.

Available to set up petroleum price records in accordance with OPA Regulations.

PETROLEUM PRICE SERVICE

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Phone: Cherry 2262

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Chemists and Engineers

Specialists on Petroleum Products

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NEWARK, N. J.

Telephone Bigelow 3-4020

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"For Sale," "Wanted to Buy," "Help Wanted," "Business Opportunities," "Miscellaneous" classifications, set in type this size without border—15 cents a word. Minimum charge, $4.00 per insertion.

"Position Wanted"—10 cents a word. Minimum charge $1.50 per insertion.

Advertisements set in special type or with border—$5.00 per column inch.

Copy must reach us not later than Saturday preceding date of issue.

All classified advertisements are payable in advance.

No agency commission or cash discounts on classified Advertisements.

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ABOUT OIL PEOPLE

Harold Hersnell, secretary of the United Oil Well Supply Co., is back at his desk in Los Angeles following a long illness.

* * *

Ward B. Blodget, vice-president of P. H. Frank, Inc., a contract drilling firm, has opened branch offices in Los Angeles. The home company is located in Bakersfield.

* * *

Dr. James Gilluly, professor of geology at the University of California at Los Angeles, last week was a guest speaker at a meeting of the Pacific section of the American Assn. of Petroleum Geologists in Los Angeles. He described his experiences in the South Pacific during the last eight months.

* * *

The Controllers Institute of America has elected to membership **Gordon B. Schaefer,** chief accountant and office manager of the Southeastern Pipe Line Co., Atlanta, Ga.; **Louis C. Stevens, Percy A. Brawley,** and **William E. Davis,** assistant controllers of Standard Oil Co. (N. J.), New York City; and **Wilfred M. Henry,** assistant treasurer and assistant secretary-controller of the Empire State Oil Co., Thermopolis, Wyo.

* * *

Dr. M. King Hubbert, research geophysicist with the Shell Oil Co. of Houston, was guest speaker before the Fort Worth Geological Society. He talked on "The Strength of the Earth".

* * *

J. F. Lewis, district manager for Shell Oil Co. at Cincinnati, has been transferred to St. Louis in the same capacity. Mr. Lewis was succeeded by **J. K. Wells,** who was Shell's district manager at Dearborn, Mich.

* * *

Two former oil men, **Henry C. Zeitz** and **Harold A. Woodhouse,** recently resigned as OPA petroleum price investigators in the Enforcement Division, and have opened a petroleum price service in Cleveland.

Mr. Zeitz was formerly with the Standard of Indiana and Gulf, and Mr. Woodhouse with Pure. They will act as consultants on OPA price regulations, and set up petroleum price records in accordance with regulations. Their offices are in the Hippodrome Bldg., Cleveland.

* * *

R. E. McDaniel has been promoted to assistant division manager of the West Virginia division of the Standard Oil Co. of New Jersey.

He succeeds **C. A. Newland,** who has been made assistant division manager of the North Carolina division of the Standard Oil Co. of New Jersey.

Mr. McDaniel joined Standard in June, 1924, as a service station salesman in Charleston. He later was made a district manager, and became merchandising assistant to the division last August.

* * *

Frank B. Taylor, well known as a writer of articles on various phases of the petroleum industry, has joined the Independent Petroleum Assn. of America as Editor of *The Independent Monthly.* He will be located at the national headquarters in Tulsa. Mr. Taylor came to Tulsa in 1936 from Texas, where he was engaged in natural gas measurement and production for Panhandle Eastern Pipe Line Co., to become Mid-Continent Editor of the *Oil Weekly.* He held this post until recently when he entered Engineering Sales and Commerce Co. as a partner, disposing of his interest in this firm late last year.

* * *

Mr. Regestein

Mr. Willetts

Herbert Willetts has been appointed assistant general manager of Eastern marketing for the Socony-Vacuum Oil Co., Inc., and **Quentin W. Regestein** has been named general manager of the New York City division, it was announced here this week.

Mr. Willetts succeeds **A. L. Nickerson,** who has been transferred to the company's foreign trade department. Mr. Willetts joined Socony-Vacuum in 1923.

Mr. Regestein has been with the company since 1931. He became district sales manager of the Northern New Jersey sales district in 1943. During the past year he has been serving as chief of the gasoline rationing branch of OPA in Washington.

* * *

John Power, of Tulsa, formerly an editorial staff writer for NATIONAL PETROLEUM NEWS, has been awarded the Navy's Silver Star Medal for conspicuous gallantry and intrepidity in action while serving aboard an infantry landing craft which was struck by Japanese torpedo planes Nov. 5, 1943. He has been in the Navy since August, 1942. The citation accompanying the award read as follows:

"Risking his life to enter the smoke and gas-filled engine room to determine the nature of the damage and extent of the fire, Power discovered a wounded shipmate and, after removing him from the throttle station, returned to the engine room and extinguished the flames.

"Realizing that a troop compartment was taking water from an unknown source, he had himself lowered into the dark and flooded area, explored the damage and rupture to bulkheads and returned to the engine room where he discovered an unexploded enemy torpedo and reported its presence. When all hands had abandoned ship, he courageously volunteered to return to the damaged vessel and assist in getting her in tow and safe to port."

* * *

Latest addition to the newly formed G. S. Price & Company wholesale petroleum marketers of Cincinnati, is **C. W. (Bud) Kopenhoefer,** who brings his 30 years of oil marketing experience to the Price organization. Mr. Kopenhoefer, who is in the sales department, was with the Boswell Oil Co. of Cincinnati for 20 years, and prior to that was with the Ohio Refining Co. of Cincinnati.

* * *

Bart Hutchins of the Oil Producers Agency in Los Angeles is watching out for the interests of the independent oil producers these days while attending legislative sessions in Sacramento.

* * *

Committee members or alternates present at a meeting of the Technical Advisory Committee of the Pennsylvania Grade Crude Oil Assn. on March 22, held at the United Refining Company's offices in Warren, Pa. included:

MacLean Houston, chairman, United Refining Co., Warren; **L. M. Baltzell,** Wolf's Head Oil Refining Co., **T. J. Harkins,** The Pennzoil Co., and **A. B. Weingard,** Continental Refining Co., Oil City; **F. A. Nicholson,** Elk Refining, Charleston, W. Va.; **J. T. McCoy,** Tide Water Associated Oil Co., Bayonne, N. J.; **W. T. Sieber,** the Waverly Oil Works Co., Pittsburgh, Pa.;

L. A. Calkins and **H. W. Hubbell** of Franklin, Pa., and **H. J. Dunmire** of Butler, Pa., Valvoline Oil Co.; **H. O. Button,** Allegany Refiners Inc., Bolivar, N. Y.; **L. C. Borell,** Franklin Creek Refining Corp., Franklin; **Andrew Mondock,** Canfield Oil Co., Cleveland, Ohio; **E. E. Ebner,** Quaker State Oil Refining Corp., Emlenton, Pa.; **J. A. Jones,** Kendall Refining Co., Bradford, Pa.; and **B. L. Heath,** Freedom Oil Co., Freedom, Pa.

Also present were **W. C. Wenzel,** executive manager, and **T. J. Garin** of the Pennsylvania Grade Crude Oil Assn., Oil City; **R. E. Hersh, Neal D. Lawson** and **E. F. Koch** of the Petroleum Refining Laboratory, State College, Pa., and **C. W. Cable** of United Refining Co., Warren.

NATIONAL FOAM

Quickly Extinguishes Terrifying Gasoline Fires

B-29 Superfortress, on Saipan, burning after having been bombed by Jap planes before fire protection was made available.

Foam is recognized today as the quickest and most efficient extinguisher of oil, gasoline and nearly all chemical fires.

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National Foam first proved its efficiency in the petroleum field where it demonstrated its ability to extinguish oil and gasoline fires more quickly and effectively than any other method. For many years, National Foam and Equipment have been used by large oil refiners and producers and by many other important industries.

Types of National Foam and proper equipment are now available to provide quick and efficient fire protection in the general industrial field—National Foam is especially recommended for activities when petroleum products, paints, oils, etc., are used or stored.

Our engineers will gladly consult with you and advise regarding the National Foam and Equipment best suited to your requirements.

BACK THE ATTACK—BUY WAR BONDS

NATIONAL FOAM SYSTEM, INC.

Specializing in Foam Fire Protection

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..the Jobber Brand

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THAT system or method of distribution which delivers goods to the consumer with efficiency and economy will merit continued public support and will continue to grow and prosper. Fleet-Wing Products are distributed exclusively by Independent Jobbers of Petroleum Products.

The record of this group in maintaining *essential* services to its customers during the war emergency is equalled by few, if any, businesses.

Despite manpower shortages, supply difficulties, regulations, red tape, and other war emergency problems with which our Jobbers and we must contend, an impartial study will indicate that an adequate supply of Petroleum Products for *essential* service has been maintained.

In addition to meeting the supply problems of a large number of Jobbers operating in 7 States, Fleet-Wing has continued to support its Distributors with effective advertising and sales promotion helps—fitted to present-day conditions and to the local needs of its Jobbers.

Performance thus indicates that Fleet-Wing and its Jobbers are serving their customers in the present emergency with efficiency and economy, and should, we believe, merit increasing public good will and patronage.

We are always glad to discuss with progressive Jobbers the advantages which a Fleet-Wing Franchise might afford them.

FLEET-WING CORPORATION

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TECHNOLOGY DEPT.

NATIONAL PETROLEUM NEWS

Monthly Technical Section Devoted to
REFINERY MANAGEMENT and PETROLEUM CHEMICAL TECHNOLOGY

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DETROIT

Section Two

April 4, 1945

HYDROCARBONS for PETROCHEMICALS

17 Petroleum Compounds Now Commercially Available For the Organic Chemical Industry

HYDRO-CARBON	PURITY %	PRESENT USES
Propane	99	Refinery Reagent Premium Fuel H_2 Manufacture
Isobutane	98	Aviation Gasoline
n-Butane	99	Premium Fuel
Isopentane	95	Aviation Fuel
n-Pentane	95	Premium Fuel
Diisopropyl	95	Aviation Gasoline
Isooctane	Isomeric Mixture	Aviation Gasoline
Butadiene	99	Synthetic Rubber
Isoprene	95	Synthetic Rubber
Dicyclopentadiene	App. 70	Intermediate
Toluene	99	Explosives
Ethylbenzene	99	Aviation Gasoline Styrene
Styrene	99	Synthetic Rubber
Cumene	95	Aviation Gasoline
Isoheptenes	Isomeric Mixture	Chemical Intermediate Aviation Gasoline
n-Hexane Concentrate	4°F. Boiling Range	Solvent
n-Heptane Concentrate	2°F. Boiling Range	Solvent

The petroleum hydrocarbons listed above are materials for chemical manufacture which are today being produced and shipped in commercial quantities from refineries and gasoline plants. All but three are of high commercial purity. Their present principal use is for wartime purposes but after the war these and many more pure compounds will be available for the organic chemical industry. Economic rather than technological factors will determine the extent of their use. (See "Wealth of Hydrocarbons are Available—at a Price", pg. R-246 of this issue.)

Bridle Wild Horsepower

and curb lowering reservoir pressures

MAINTENANCE of Pressure on Oil Reservoirs Thru Gas Injection Will Usually:

1. Increase Total Oil Recovery

2. Minimize Lifting Costs

A properly designed and constructed pressure maintenance plant will, in many cases, provide a return on the investment greater than that received on any other invested capital in the field development.

Thru having designed and installed plants* now daily returning many hundreds of millions of feet of gas to producing reservoirs, Hudson is equipped, thru years of successful experience, to design and install complete facilities for pressure maintenance, including gathering systems, compressor plants, hydrocarbon extraction and fractionation units, dehydration plants, and dry gas injection piping systems.

*GAS COMPRESSOR STATIONS • CYCLING PLANTS • GAS DEHYDRATION PLANTS • NATURAL GASOLINE PLANTS • FRACTIONATION UNITS • HYDROGEN SULPHIDE REMOVAL PLANTS • MECHANICAL AND NATURAL DRAFT COOLING TOWERS

HUDSON

ENGINEERING CORPORATION

Engineers and Constructors

FAIRVIEW STATION HOUSTON, TEXAS

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PREVIEW

Feature Articles Coming Next Month

• • •

Introducing a New Feature—"Industrial Lubrication"

The marked developments which have taken place in recent years in industrial lubrication have greatly stimulated interest in the manufacture and application of these types of petroleum products. However, the published technical literature in this field is very limited.

Accordingly, NPN's Technical Section has arranged with a well known authority in this field to contribute regularly on this subject, starting in May. This feature will be presented in the form of Questions and Answers on the lubrication of steam engine cylinders, steam turbines, bearings, and other phases of the application of mineral oils to industrial work.

Trends in Design of Natural Gasoline Plants

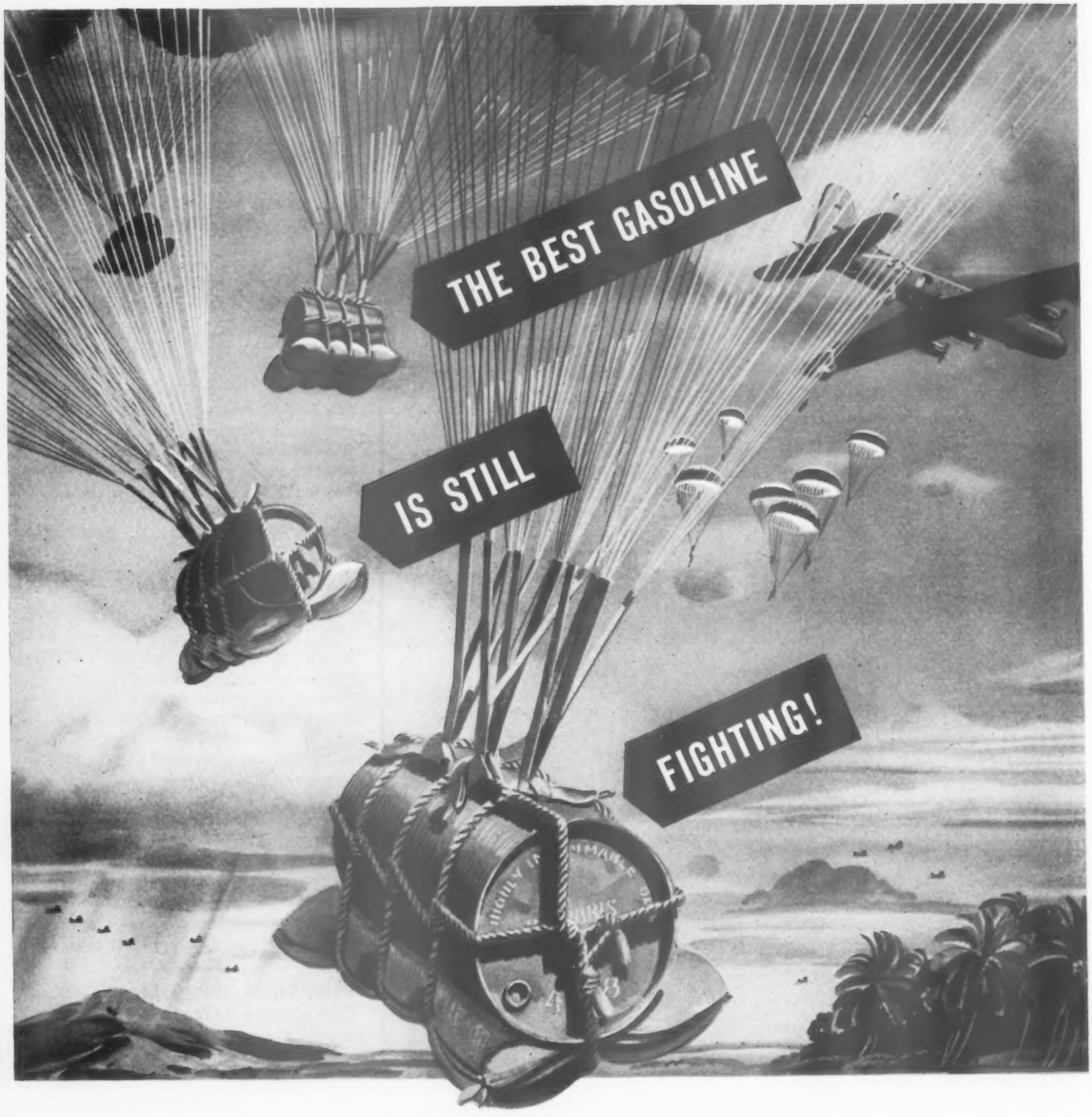
The impact of war demands for pure light hydrocarbons and increased emphasis on conserving natural resources has been strongly reflected in engineering designs for natural gasoline and cycling plants. An engineering authority who has had extensive experience in the design and construction of these plants discusses current engineering practice and forecasts future trends. The article, a Technical Section exclusive, covers present practice in demethanization, absorption at higher pressures in connection with pressure maintenance projects, production of light hydrocarbons in terms of additional fractionating and storage facilities in old or new plants, and future trends in design.

Lube Oil Refinery Is Completely Integrated

A completely new lubricating oil plant, built entirely from the ground up and without the necessity of conforming to existing equipment, has been in operation for over a year at one of Canada's largest refineries. How each unit was designed and laid out to dovetail into the over-all picture, resulting in an efficient and integrated refinery, is told by an NPN Technical Section writer after a personal inspection of the facilities.

Liquid Products Recovery From Cycling Plant

Debutanized condensate, iso- and normal butane, and 16-lb. RVP natural gasoline are recovered in a new cycling plant in the Paloma field in southern California. The wet gas and condensate are taken from 23 wells from 10,000 to 11,000 feet in depth and residue gas is returned to the reservoir at approximately 4500 lbs. pressure. The plant is a unitized operation of six oil companies.



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REFINERY MANAGEMENT *and*
PETROLEUM CHEMICAL TECHNOLOGY

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'CAT CRACKER' TURN-AROUND

Only Minor Repairs and Improvements Found Necessary After 300 Continuous On-Stream Days of Fluid Catalyst Unit: Fractionator Modified and Precipitators Strengthened

THE shutting down of the first of the three Fluid Catalyst cracking units at the Lake Charles Tutwiler refinery of Cities Service Refining Corp. had been awaited as considerable of an event ever since it became apparent the unit was headed for a record run.

When it finally was taken off-stream, Feb. 5, it had completed 300 continuous on-stream days. It is emphasized by refinery officials, however, that the unit was brought down solely because there was no desire to take chances on any portion getting dangerously near failure and to stagger turn-arounds on the three Fluid units to avoid pile-up of maintenance.

Company officials give full credit to the advice and operating experience of other oil companies, process licensors, and contractor's engineers for the record run this unit has made. Things which went wrong with other units were gotten around by this free exchange of information and operating difficulties which in the past have brought down other units of this type were avoided at the Lake Charles refinery.

For example, the fractionator tower bottoms were found to contain a large amount of coke which, for a time, threatened to plug the tower and to render it inoperable. On the advice of other operators of Fluid units, however, bottoms lines were piped to a blow-down drum, intermittent use of which permitted "flushing" of the tower sufficiently to relieve incipient plugging.

Three Weeks for Turn-Around

As a result of preliminary inspections while the unit was running, it was decided to allocate approximately three weeks to the turn-around and to set up some 20,000 man-hours for improvements. This last item included modifying the fractionator, strengthening the precipitators, adding further instrumentation, and installing several auxiliary lines and services dictated by operating experience.

It was known also that some of the slide-valves controlling catalyst movement were eroded and these were scheduled for minute inspection. Then, too, hot spots on the recycle catalyst standpipe would require re-installation of some 40 ft. of 30 in. diameter Insideline pipe, it was anticipated.

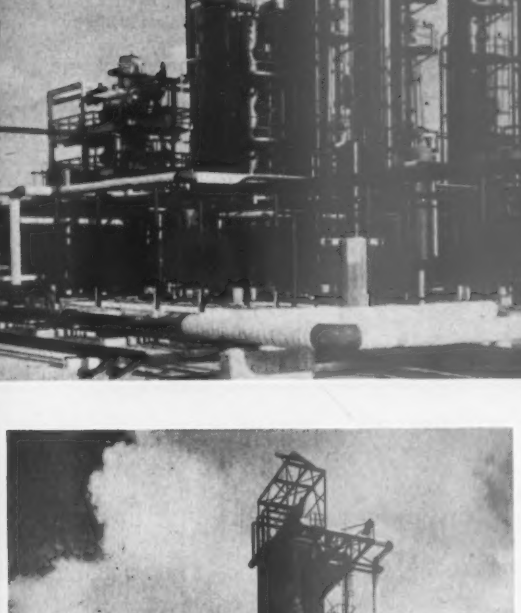
When the unit finally came down, its condition was as expected.

The lower slide-valves on the regenerator were determined to be somewhat eroded and therefore repairable, but still in good enough condition at inspection to have operated considerably longer without difficulty. None of the other valves was damaged sufficiently to warrant much repair. In the waste-heat boiler some tube-leaks were found. Outside of these relatively minor details and the items already marked for attention, the unit was found to be in good shape.

Accordingly, in addition to the company men on the job, several contract crews were put to work, and repairs proceeded apace. All the items for which need was foreseen were already on hand at the unit.

A number of visitors were present at the turn-around, in addition to company operating officials and this writer. Representatives of process owners, the contractor and several companies in the area

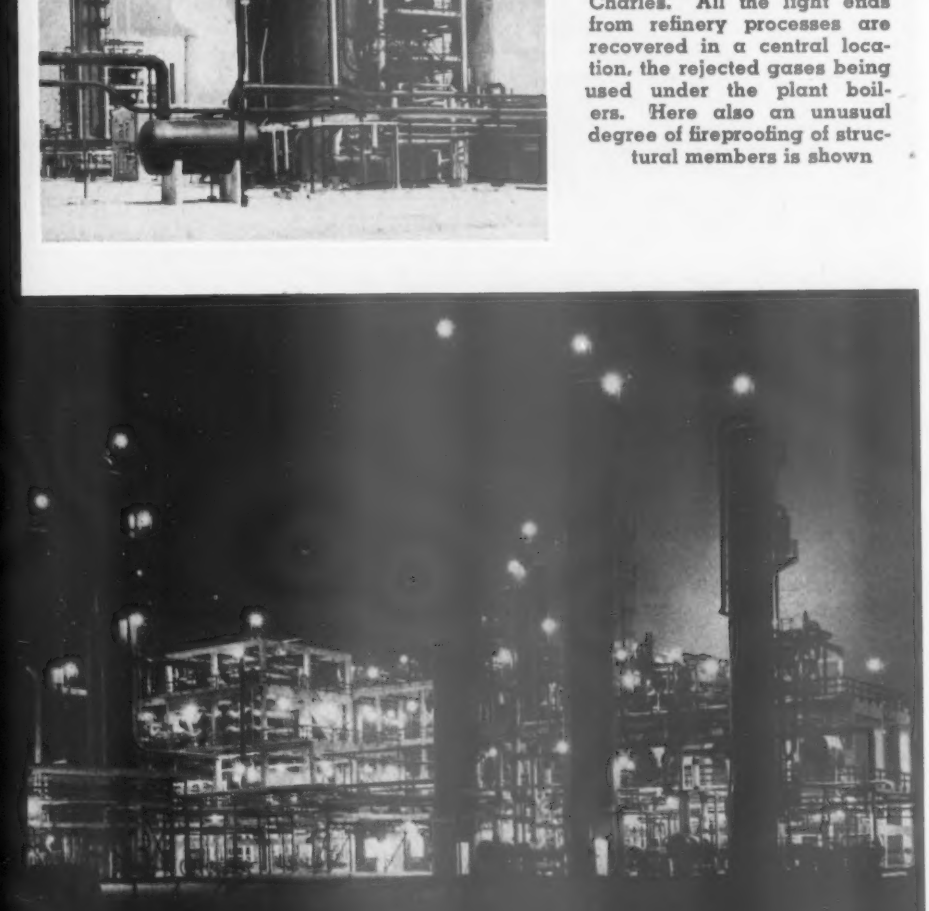
Three Fluid Catalyst units at the Lake Charles refinery, each of 15,000 b/d nominal charging capacity. In the foreground is the "A" unit, which was taken down in February for a turn-around after a record 300-day run. Fireproofing of important structural members has been carried out to an unusual extent on these units.



ABOVE—The light oil treating plant where No. 2 fuel oil, kerosene and gasoline are doctor- and clay-treated

LEFT—Two conventional sulfuric acid alkylation units which make propylene, butylene and amylene alkylate for 100-octane gasoline. Fractionator columns purify the raw feed and also cut the final product into aviation and heavy alkylate

BELOW—Night view of the gas recovery unit at Lake Charles. All the light ends from refinery processes are recovered in a central location, the rejected gases being used under the plant boilers. Here also an unusual degree of fireproofing of structural members is shown



who are operating Fluid units were on hand to compare notes and carry back information which will be useful in their own operations, or future changes in unit design.

Few Operating Troubles

Now that more than 10 months have passed since the first unit commenced operation at the huge Cities Service Tutwiler refinery at Lake Charles, it is possible to evaluate the validity of design assumptions in terms of practical operating results. On the whole, said refinery technicians, performance has gone pretty much according to plan. There have been no serious upsets to operations and no single unit has failed to perform its job properly, so that extensive modification of units has been unnecessary. There have been few complications in the way of operating difficulties.

True, there have been dilemmas. For one, it was necessary to train an extremely large proportion of "green" men for operating crews. Even most of the skilled operators had no previous experience on many of the catalytic operations involved. For another, it was not a question of starting up several additions to an existing plant; all of the units were new and built with almost the irreducible minimum in the way of standby facilities, valves, by-pass arrangements, instruments and even storage. Nevertheless, the refinery has been continuously on-stream and a record in Fluid catalytic cracking operation has been established.

Three Claims to Fame

There are three claims to fame made for this refinery, aside from the prime consideration that it was designed to produce efficiently as much 100-octane aviation gasoline as possible from the least amount of crude, using a minimum of critical material and equipment:

1—The plant was built to a "master-plan" of maximum integration of all units, both process- and space-wise, with provision for future expansion as required.

2—The refinery was constructed from the ground up, in the midst of a virgin growth of pine forest where no refinery existed previously.

3—It is the first commercial application of propane deasphalting and desalting of reduced crude to supply a large proportion of feed stock for catalytic cracking.

After construction was completed in the Spring of '44, the initial step in operations was cleaning out, testing and breaking in the various units as fast as the construction workers could be gotten out of the way. This actually added to the ordinary hazards of initial operations, for not infrequently construction crews were separated from a companion, but operating, unit by a thin strand of wire and appropriate warning signs.

Immediately prior to this, Cities Serv-

ice had searched its various affiliates for every trained man who could be spared by an increase in work week. The skilled men thus squeezed out were transferred to Lake Charles to add to the nucleus of the new plant's personnel. These men, plus those secured by direct recruiting from outside then were put through an intensive training course. This included visits to the equipment in question while it was being built, as well as intensive classroom instruction on the how and the why of the unit or operation in question. A few key personnel, in addition, were sent to other refineries for training. Engineers of the M. W. Kellogg Co., prime contractors for the entire installation, assisted in starting up the first of several types of units; Cities Service men started all the others when they were ready.

20 Units Put On-Stream

As soon as the break-ins were over, all units commenced regular operations the moment sufficient feed stock was available. Twenty large process units were put on-stream during a 120-day period.

Naturally, none of this was accomplished as simply as the preceding paragraph might imply. Actually, a number of difficulties were encountered which might have been extremely serious. For instance the plant was built with the very minimum of "spare" equipment of every kind; thus what might be the relatively simple matter of an improperly functioning pump being relieved for maintenance by by-passing and switching to a spare in the normal refinery, here meant nursing the ailing mechanism along until the trouble could be remedied without shutting down the unit.

Instrument men worked miracles, process men say, in getting instruments adjusted and keeping them functioning properly without bringing down either the unit or taking the instrument out of service. Not the least of their difficulties was that, in deference to the war effort, installations had been made without the usual facilities in the way of block valves and by-pass arrangements.

An interesting document is the report of 1944 operations at the refinery made to management by the refinery supervision. In it, many times in a few offhand words, is a record of some of the perplexing problems which were encountered and solved. There is a quiet note of pride, too in the results achieved. The following paragraphs are condensed from this report:

Identical-design topping units have operated at 25% above design capacity.

Pump, motor and electrical troubles were beyond expectations in early operations; gland-oil system had to be altered.

Considerable trouble from salt—plugging exchangers and causing hot spots to develop in tubes—was experienced; caused several shutdowns.

Propane deasphalting unit turned in an operating service factor of 96.5%. It produced an 85% deasphalted gas oil from reduced crude, considerably better than the 60% expected from design calculations. Conradson carbon residue of the product averages between 2.0 and 3.0%.

The three Fluid catalytic crackers have been operated continuously from the break in. Unit "A" made a record run of 7200 hours—300 days—without a shut down, while Unit "B" will have exceeded this figure by the time these words are published. Some operating difficulties have been experienced with all three units, although not always within the control of the operators, such as utility failures.

"A" unit, for example, had compressor troubles; coke built up in the fractionator tower and demanded stop-gap measures to avoid shut down; internal insulation failed on the recycle catalyst standpipe which forced by-passing the recycle catalyst cooler. Leaks developed in seams of the precipitators necessitating temporary welds to stop catalyst leaks.

"B" unit also has had trouble with precipitators, plus a leaky expansion joint on the recycle catalyst cooler. Slide valves, controlling catalyst flow on "C" unit, are showing signs of excessive wear due to the coarse size of catalyst being used. They will have to be repaired in the near future and this unit likely will be next of the three to be brought down for maintenance.

The two sulfuric acid alkylation units have functioned unusually well, according to the process department report. No extraordinary operating difficulties have ensued and more than design quantities of aviation grade alkylate have been produced.

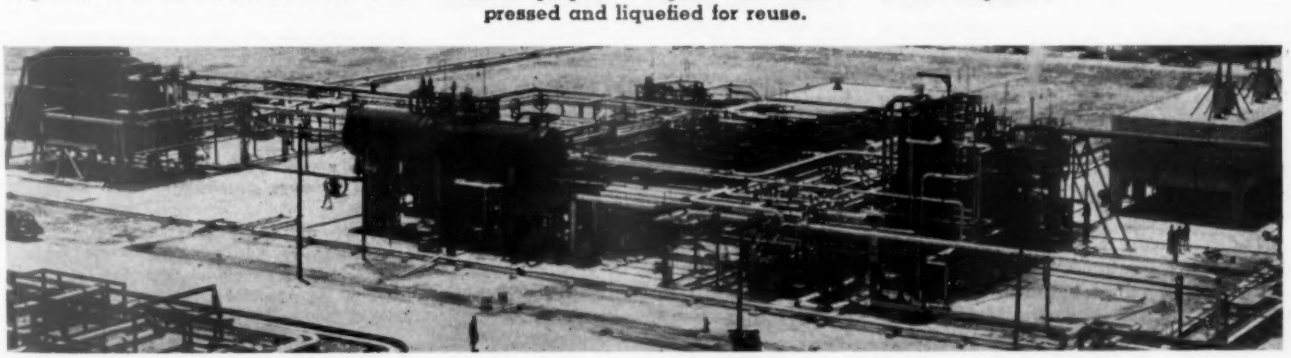
The isomerization unit (aluminum chloride catalyst with anhydrous hydrogen chloride as promoter) made more than 315,000 bbls. of isobutane in 1944. It was run 131 days before excessive catalyst carryover forced change of catalyst (redeposition on "Porocel" support) in the converter.

The acid plant has given considerable operating trouble when compared with the other refinery units. However, since it is essentially a high-maintenance unit, difficulties encountered are not considered unusual. Rather, they are common to acid plants, the report states. Chief offender has been the lead piping and tower linings springing leaks. This unit operates by burning "spent" acid in a furnace, temperature and oxygen content being just enough to oxidize the hydrocarbons to carbon dioxide and water, and decompose sulfur compounds to sulfur dioxide. Elementary sulfur also is burned to SO_2 in sufficient quantity to make up any lack of this material in producing the quantity of finished sulfuric acid desired. The SO_2 gas then is purified, dried, catalytically converted to sulfur trioxide and absorbed in 98% sulfuric acid and diluted to make quantity and strength needed.

In 1944 the acid recovery plant produced 77,713 tons of sulfuric acid, more than could be absorbed by refinery operations and all excess acid was shipped to other aviation gasoline refineries. During the month of December this plant operated at 128.5% of rated capacity.

The transfer department, a separate department charged with movement of all hydrocarbons from storage to units and vice versa, is unique. It is designed to operate a complex refinery with minimum tankage, pumps, lines, valves, and labor.

The refinery as a whole actually shipped nearly 16,000,000 bbls. of all products in 1944 operations although not formally dedicated until May 26, at which time some construction was still to be completed.



Propane deasphalting unit at the Lake Charles refinery, which prepares heavy gas oil for "cat cracker" feed stock after it has been desalted and deasphalted. At the left is the heater, which supplies heat for stripping propane from asphalt center, the propane storage and the processing unit, consisting of settlers and propane strippers; right, the compressor house, where propane vapors are compressed and liquefied for reuse.

Wealth of Hydrocarbons for Manufacturing Petrochemicals Are Available—At a Price

Some Compounds Are Now Being Produced as By-Products at Relatively Low Costs. Many Others Can Be Recovered in the Degree of Purity Required Only at Much Higher Costs than in Making the Volume Products

ECONOMICS will be a controlling factor in the manufacture of chemical intermediate products from petroleum hydrocarbons, J. H. Boyd, Jr., assistant manager, Chemical Products Department, Phillips Petroleum Co., recently told a group meeting in New York.

Petroleum offers the organic chemical industry a wealth of new raw materials for organic synthesis, said Mr. Boyd. The techniques for recovering these compounds in the high degree of purity required in chemical manufacture are known, and in some cases are even now in commercial use.

Some of these hydrocarbons are being produced at petroleum refineries at relatively low costs since they are by-products of other operations. However he pointed out, to manufacture these and many other compounds of the high degree of purity required in chemical manufacture will entail much higher costs when their production is a primary refining operation. A principal portion of Mr. Boyd's paper follows:

By J. H. BOYD, Jr.

CONSIDERABLE progress has been made in expanding our knowledge of the more volatile constituents of petroleum. In Table I are given the results of the investigation by Forziati, Wellingham, Mair, and Rossini[7] of the composition of the naturally occurring naphthas from seven different crudes. Normal paraffins, isoparaffins, alkylcyclopentanes, alkylcyclohexanes, and aromatics are reported found in the naphthas with the differences from one crude to another being essentially in the relative amounts of the foregoing five classes of hydrocarbons.

The table suggests in compelling fashion the complexity of the problem of the separation of individual gasoline hydrocarbon components from crude petroleum. It also shows significantly the possible variation in yield of individual hydrocarbons from crude to crude and hence the potential variation in availability of a hydrocarbon from one refinery to another. The picture of availability is further complicated by the differences in refinery operations necessitated by differences in crude source, equipment available, market conditions, and company policies.

In the early days of petroleum refining simple distillation was used to effect rough separations of hydrocarbons of different volatilities. Today more precise distillation methods are available in fractionation, superfractionation, azeotropic distillation, and extractive distillation. Crystallization, extraction, and the other refining processes can be utilized if occasion demands and economic return warrants.

The physical basis for the possible combination of fractionation and crystallization to effect hydrocarbon preparation as shown in Table 2[16] is the effect of structure in spreading the freezing point of hydrocarbon isomers of approximately the same boiling point. As shown, a highly branched octane with only 8 carbon atoms can have a higher freezing point than *n*-nonacosane with 29 carbon atoms.

While fractionation is a friend of long standing in the petroleum industry, the newer distillation techniques are undergoing rapid industrial development. Typical fractionation operations utilize columns with 20 to 30 plates and a ratio of reflux to overhead products of about 2 to 1. Super fractionation utilizes 100 to 150 plates and reflux ratios up to 50 to 1. Azeotropic distillation operations will require from 50 to 100 plates depending on the exact system used. Methanol is used to separate toluene from cracked motor fuel fractions[15] and the use of sulfur dioxide in butane-butene separation is reported by Matuszak and Frey[13]. Mair, Glasgow, and Rossini[12] discuss in detail the laboratory aspects of the separation of hydrocarbons by azeotropic distillation. Extractive distillation or distillation carried out in the presence of a relatively high boiling polar solvent is exemplified by the use of furfural in the purification of butadiene[2, 10, 11].

These procedures are powerful tools for the separation of hydrocarbon mixtures, but the newer distillation operations all require more equipment and hence higher capital charges per unit of production. The development of superfractionation, azeotropic and extractive or absorptive distillation is so new that full scope of their industrial application is not yet realized.

Selective solvent extraction of light fractions is illustrated by the commercial Edeleanu process utilizing sulfur dioxide in extraction of aromatics from kerosene fractions[4]. Doubtless other applications of this technique to petroleum refining operations can be made after the war. Crystallization and adsorption are tools not yet applied commercially to light hydrocarbon separation but are available for exploitation. Thus the foundations of a technology have been laid which promise to make available to the organic chemical industry at a price any hydrocarbon found in straight-run or cracked naphtha fractions.

In further consideration of the economics of hydrocarbon intermediate supply, it should be recognized that a commercially pure material, say 95% or better, is going to be recovered in relatively low yield from the crude. For example, take the case of *n*-decane occurring in 13.6% concentration in the naphtha fraction from Ponca City Crude as reported by Rossini[17] in Table 3.

While *n*-decane is present in 13.6% concentration in the distillate, the concentration is only 1.0% in the crude. Thus there is a practical limit to the amount of a given hydrocarbon which a refiner can supply. Table 3 also shows the presence of mixed ring or cycloparaffin-aromatic structures.

It is axiomatic in any business run for profit that the customer pays for any new plant needed to meet his requirements and this is particularly applicable to any new highly specialized product. These hydrocarbon intermediates are highly specialized from a petroleum point of view. The problem of investment charges per unit volume of hydrocarbon intermediates becomes more acute on consideration of the great physical disparity in petroleum and chemical processing operation. This can be readily appreciated on comparing the physical volume of crude petroleum production with the total volume production of organic chemicals in 1943 as shown in Table 4[5, 14].

The phenomenally low unit costs for

The accompanying article is the principal portion of a paper presented under the title "Petroleum—Source of Raw Materials for Chemical Industry." The early portion of the paper is omitted; this describes the characteristics of crude petroleum and the fundamentals of refining processes, with which most readers are already familiar. The complete paper was published in the Feb. 25th edition of Chemical and Engineering News of the American Chemical Society. Mr. Boyd is Assistant Manager of the Chemical Products Department, Phillips Petroleum Co.

TABLE 1—Data on Straight-Run Naphtha Composition

Amounts of individual hydrocarbons (paraffins and naphthenes, 40° to 102° C., 104° to 215.6° F., and aromatics to 160° C., 320° F.) in the original naphtha (approximate)

Component	Boiling Point at 1 Atm., °C.	Percentage by Volume of Distillate, 40° to 180° C. — Paraffin and Naphthene: Ponca, Okla.	East Texas	Bradford, Pa.	Greendale-Kawkawlin, Mich.	Winkler, Texas	Midway, Calif.	Conroe, Texas	±
Cyclopentane	49.26	0.14	0.28	0.21	0.24	0.30	0.73	0.23	0.05
2,2-Dimethylbutane	49.74	0.11	0.17	0.15	0.05	0.23	0.25	0.19	0.05
2,3-Dimethylbutane	57.99	0.23	0.41	0.43	0.30	0.52	0.30	0.31	0.05
2-Methylpentane	60.27	1.12	2.39	3.42	1.34	1.67	1.68	1.53	0.05
3-Methylpentane	63.28	1.04	1.82	2.04	0.88	4.18	1.14	1.07	0.05
n-Hexane	68.74	5.39	4.78	5.79	11.24	1.13	1.88	2.36	0.04
Methylcyclopentane	71.81	2.60	3.61	1.38	1.56	1.55	3.98	2.82	0.04
2,2-Dimethylpentane	79.20	0.29	0.91	0.86	0.30	0.83	0.45	0.40	0.08
2,4-Dimethylpentane	80.51								
Cyclohexane	80.74	2.13	1.83	1.79	1.99	0.61	2.47	4.13	0.06
(2,2,3-Trimethylbutane)	80.88	....	....	....	....	....	....	....	....
(3,3-Dimethylpentane)	86.06	....	....	....	....	....	....	....	....
1,1-Dimethylcyclopentane	87.5	0.49	0.55	0.53	0.36	0.62	0.57	0.43	0.16
2,3-Dimethylpentane	89.79	13.23	3.50	3.67	1.88	4.47	2.14	2.36	0.20
2-Methylhexane	90.05								
trans-1,3-Dimethylcyclopentane	90.8	3.55	3.89	1.50	0.68	1.54	5.21	1.48	0.25
trans-1,2-Dimethylcyclopentane	91.9	1.22	1.56	1.41	0.24	1.19	2.03	0.39	0.20
3-Methylhexane	91.95	0.98	1.16	1.51	0.36	3.68	0.60	0.45	0.20
(3-Ethylpentane)	93.47	....	....	....	....	....	....	....	....
(*cis*-1,3-Dimethylcyclopentane)	?	....	....	....	....	....	....	....	....
n-Heptane	98.43	6.81	4.61	7.07	13.17	1.27	1.18	3.30	0.05
(2,2,4-Trimethylpentane)	99.24	....	....	....	....	....	....	....	....
(*cis*-1,2-Dimethylcyclopentane)	99.3	....	....	....	....	....	....	....	....
Methylcyclohexane	100.93	4.86	6.54	5.75	4.10	1.47	5.95	9.61	0.08
Total		34.19	38.01	37.51	38.69	25.26	30.56	31.06	
Aromatic									
Benzene	80.10	0.46	0.21	0.19	0.63	0.13	0.20	1.23	0.03
Toluene	110.62	1.53	1.73	1.52	1.77	0.26	1.28	7.37	0.03
Ethylbenzene	136.19	0.56	0.68	0.26	0.36	0.23	0.66	0.93	0.06
p-Xylene	138.35	0.29	0.50	0.50	0.28	0.36	0.44	1.78	0.06
m-Xylene	139.11	1.53	1.93	1.83	1.20	0.24	1.08	6.10	0.10
o-Xylene	144.42	0.80	0.88	0.63	0.52	0.09	0.63	2.04	0.04
Isopropylbenzene	152.40	0.21	0.16	0.10	0.13	0.30	0.26	0.32	0.03
n-Propylbenzene	159.22	0.24	0.23	0.16	0.14	0.20	0.21	0.42	0.04
Total		5.62	6.32	5.19	5.03	1.81	4.76	20.19	
Total known composition		39.81	44.33	42.70	43.72	27.07	35.32	51.25	

the processing of petroleum are due primarily to the tremendous quantities processed in a given operation. In addition, most petroleum products are used as fuels or lubricants and in these applications mixtures of different hydrocarbons are permissible. However, the organic chemist in general desires pure materials with which to work because of the simplification in chemical processing and the improved yields. There are substantial savings in chemical industry in using pure hydrocarbons but in practically every instance the chemical industry will have to bear the cost of any special purification required.

In some cases relatively pure hydrocarbons are available at low prices because the separation is inherently easy or has been justified for petroleum purposes and not to provide a chemical intermediate. The chemical industry is the beneficiary of this fortuitous set of circumstances. When, however, the chemical industry demands a pure hydrocarbon which is not available as such, the price of the hydrocarbon intermediate goes up. Any specification on a product increases its price regardless of the field of endeavor. Distilled water costs more than sea water. A mercaptan-free gasoline costs more than a sour gasoline. Any pure product costs more than the concentrate from which it comes.

Occasionally these differences in cost have been brought to the minimum through large-volume processing, but the chemical demand for hydrocarbon intermediates at best is measured in tank car quantities and this is a modest operation by petroleum standards. Hence the equipment charges for new plants installed to provide intermediates will be high relative to ordinary refinery costs. It is for these reasons that it behooves the organic chemist to consider well the specifications which must be imposed upon a hydrocarbon intermediate in order to meet his requirements. Frequently a compromise between hydrocarbon costs and high yield or convenience must be struck if the intermediate price is to be in the practical range.

In a process sense, a by-product occurs fortuitously as a result of an operation with another end result as its objective. If a substance is truly a by-product there can be no specification on it, since otherwise it loses its definitively fortuitous character. Typical properties can be used to describe by-products but no assurance can be given as to uniformity of product or continuity of supply if they are to be sold on what is essentially a distress price basis. Any guarantee of continuity of supply by a re-

TABLE 2—Effect of Structural Symmetry on the Freezing Point of Hydrocarbons

	Boiling Point, °C.	Freezing Point, °C.
Octane isomers, C_8H_{18}		
2-Methyl heptane	117.2	—111
n-Octane	125.6	— 57
Tetramethylbutane	106.5	+104
n-Nonacosane, $C_{29}H_{60}$	295/15 mm.	+ 64
Xylene isomers, C_8H_{10}		
m-Xylene	139.1	— 48
o-Xylene	144.1	— 25
p-Xylene	138.3	+ 13

TABLE 3—Concentration of Some Kerosene Hydrocarbons in Ponca City Crude

Hydrocarbons	Volume Per Cent—In 392–446° F. Distillate	Volume Per Cent—In Crude
n-Decane	13.6±0.8	1.0
1,2,3,4-Tetramethylbenzene	..	0.078
5,6,7,8-Tetrahydronaphthalene	0.15	0.020
1-Methyl-5,6,7,8-tetrahydronaphthalene	..	0.048
2-Methyl-5,6,7,8-tetrahydronaphthalene	..	0.050
Naphthalene	..	0.034
1-Methylnaphthalene	..	0.062
2-Methylnaphthalene	..	0.132
Total	19.4±0.8	1.4

finer immediately decreases the flexibility of his own operations at a potential money cost to him. If the sale of the so-called by-product on a continuing commitment is to be attractive, adequate compensation must be made. This is a point of view all too frequently disregarded and one which must be kept constantly in mind when considering petroleum as a source of hydrocarbons for the chemical industry.

Despite these discouraging remarks with respect to the cost of petroleum hydrocarbons, there is a group available at a low price. These are the liquefied petroleum gases which include propane, isobutane, *n*-butane, isopentane, and *n*-pentane, derived from natural gasoline. The markets for these gases lie largely in the northeastern U. S., in which area the supply is inadequate to meet the demand, and so large volumes are brought in from the southwest. Accordingly, the market price structure has been built up on an f.o.b. Group III (southwest) basis, for the reason that any locally produced liquefied petroleum gas which is diverted to a chemical use must be replaced by material brought in from the southwest, and the delivered cost to the customer is the price Group III plus freight. In order to have a common price base for reference it has proved in practice most satisfactory to quote these materials on a Group III basis.

Propane and butane find large outlets as premium fuels for heat-treating metals, singeing textiles, and for domestic use. *n*-Pentane finds outlet as a fuel. Isobutane, isopentane, diisopropyl[5], and isooctane are important in the manufacture of aviation gasoline. Butadiene is familiar to all as the dominant raw material for synthetic rubber. Isoprene finds a limited use in the manufacture of Butyl rubber and in some specialty rubbers. Dicyclopentadiene of approximately 70% concentration is reported to be available and used in polymerization. The present production of toluene, 90% of which comes from petroleum, has enabled the Army to use TNT without stint.

Ethylbenzene is made by the alkylation of coal-tar benzene with ethylene from petroleum. It is made primarily for subsequent dehydrogenation to styrene but in recent months much has been diverted to aviation gasoline blending. Styrene is the lesser co-monomer used with butadiene in the manufacture of GR-S. Cumene or isopropylbenzene is an aviation gasoline ingredient. Mixed isoheptenes is a mixture of olefin polymers averaging 7 carbon atoms per molecule. The *n*-hexane and *n*-heptane concentrates are notable for their remarkably narrow boiling ranges. As solvents and in extraction operations they behave as pure compounds and are of value as reaction media, solvents, precipitation agents, and extractants.

TABLE 4—Physical Volumes of Organic Chemical and Petroleum Operations in 1943

	Bbl. (42 gal.) per day
Organic chemicals	78,000
Crude petroleum	4,500,000
Motor gasoline	1,500,000
Aviation gasoline	400,000

Many of these materials are in such demand that the supply is now inadequate and so cannot be regarded as satisfactorily available for all uses. But, in general, chemical uses carry sufficient priority to make even most aviation gasoline ingredients available for such use. Table 5 lists the commercially available hydrocarbons cited above with their estimated commercially available purity and current large uses.

Other postwar hydrocarbon possibilities are:

Propylene, isobutylene, butene-1, butene-2, *n*-hexane, *n*-heptane, isooctane, and olefin polymers. Propylene, isobutylene, butene-1, and butene-2 will doubtless be available in concentrates but if high purity is required it is almost certain that their price will be substantial. *n*-Hexane, *n*-heptane, and isooctane can be made available at a price. Other olefins and olefin polymers can also be made available, but if tailor-made hydrocarbons are required they will not be cheap.

TABLE 5—Commercial Petroleum Hydrocarbons

Hydrocarbon	Estimated Purity Available at a Price, %	Present Uses[a]
Propane	99	Premium fuel, refinery reagent, H_2 manufacture
Isobutane	98	Aviation gasoline
n-Butane	99	Premium fuel
Isopentane	95	Aviation gasoline
n-Pentane	95	Premium fuel
Diisopropyl	95	Aviation gasoline
Isooctane	Mixture of isomers	Aviation gasoline
Butadiene	99	Synthetic rubber
Isoprene	95	Synthetic rubber
Dicyclopentadiene	Approx. 70	Intermediate
Toluene	99	Explosives
Ethylbenzene	99	For Styrene and for aviation gasoline
Styrene	99	Synthetic rubber
Cumene	95	Aviation gasoline
Isoheptenes	Isomeric mixture	Chemical intermediate and in aviation gasoline
n-Hexane concentrate	4° F. boiling range	Solvent
n-Heptane concentrate	2° F. boiling range	Solvent

[a]Not necessarily in maximum purity.

Conclusion

It is clear that petroleum offers the organic chemical industry a wealth of new raw materials for organic synthesis. The supply of pure hydrocarbons potentially is large. Techniques for their separation are already in commercial use but their development is far from complete. Insistence on high purity increases the cost of the hydrocarbon and this penalty is greater the higher the average molecular weight, owing to the greater complexity of the mixture from which it is recovered and the increasing processing required to effect the separation.

Petroleum by-products cannot be held uniform in quality and warranted as to continuity of supply and be available on a distress price basis. Any restrictions imposed by the buyer on the seller with respect to either of these points must of necessity increase their price. Today 17 hydrocarbons are being produced and shipped in commercial quantities; all but three are of high commercial purity. Some are naturally occurring hydrocarbons, but many are synthesized to meet the needs of the war aviation gasoline and synthetic rubber programs. While current supply may be tight, in general chemical needs carry sufficient priority to release them for such application. Postwar additional hydrocarbons will be available and the organic chemical industry can write the ticket if it is prepared to pay the price.

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DISCUSSION ON ALCOHOL-WATER INJECTION

AN ALREADY publicized group of automotive engineers are not alone in their experimental work with water and alcohol injection in gasoline engines as a possible means for improving engine performance. Some oil companies have also carried on studies in this field over a considerable time, comment to NPN's Technical Section brings out.

This comment followed publication in the Feb. 7th issue of the Technical Section (pgs. R-88 to R-96) of a paper by engineers associated with Thompson Products Inc. of Cleveland which was presented at the annual War Engineering meeting of the Society of Automotive Engineers in Detroit in January.

This paper described experiments with water-alcohol injection under controlled operating conditions as a detonation depressor. The Thompson Products company has developed an automatic injection device for installation on trucks and passenger cars, which is popularly known as a vitameter. It is understood it will be widely marketed after the war.

Comment from oil company technologists in general recognizes the principle of reducing knock, or providing internal cooling or possibly other benefits through the injection into the cylinders of material supplementary to the fuel itself. Many points have been raised through the oil companies' studies, however, on which it is felt that further research is necessary before the practical possibilities for general application can be definitely determined. Some of these points are brought out in the following portion of this article:

"The principle of using an anti-knock material only when engine conditions are conducive to detonation can also be applied to an all-petroleum system," stated T. G. Delbridge, manager of the Research and Development Department, Atlantic Refining Co. "For example, instead of an alcohol-water mixture it would be feasible to have an extremely high octane number, leaded blend as the auxiliary fluid.

"Preliminary calculations indicate that a high octane component of aviation gasoline containing tetraethyl lead will accomplish the same detonation suppression as an alcohol-water mixture for an equal amount of money spent for the auxiliary fluid.

In commenting on the possible introduction to the public of injection apparatus to be installed on cars and trucks, another well known authority stated: "The American motoring public does not appreciate extra servicing points. After the war the refining industry will supply the needed anti-knock quality through means of the fuel, so that it will always be available.

"Commercial fleets might be tempted to try a device to prevent detonation but, if detonation is brought about by overloading of equipment rather than gasoline deficiency, the chances are that elimination of peak detonation would encourage overloading which would result in more rapid equipment breakdown."

Obstacles Seen to a Two-Fuel System For General Use on Automobiles

By H. C. Hunter

The following report was prepared by H. C. Hunter, of Gulf Research & Development Co., following a round-table discussion of the SAE alcohol-water injection paper in which a group of engine-laboratory technologists from different companies participated:

THE general sense of a recent informal discussion was that there were probably more obstacles to be overcome in getting general commercial acceptance of a two-fuel system than it would be worth in technical advantages. Among the factors mentioned were the following:

1. The cost of a dual metering device compared with a plain carburetor. It was recalled that the motor makers consistently refuse to equip their products with *good* carburetors at a slight increase in cost over mediocre ones because the public's ability to perceive the difference is less than the stockholders' awareness of the total annual loss of some hundreds of thousands of dollars which the difference in cost would mean.

2. The reliability of the injection proportioning or metering device. Judging by past experience with similar mechanisms, in particular a device for this very purpose which has been promoted actively since 1941, the apparatus is very likely to work satisfactorily at first and then to fall into disuse with the first appearance of trouble, as long as high enough octane number gasoline is available at a price. Eventually, of course, improvements would bring the reliability up to the level of the carburetor, provided it was not killed commercially during the period of numerous complaints.

3. Studies made in the oil company laboratories indicated that the economic benefit of auxiliary injection of alcohol-water is greatest at low load factor operation, and hence would not be so attractive to truck and bus application, which is just the field in which it would have a chance to survive the introductory trouble period while improvements were being made in the devices.

4. Although alcohol-water mixture would be a very appreciable added expense to vehicle operators, it was noted that plain water could be used most of the year.

5. Oil company laboratory experiments have indicated the requirement of injection liquid is 15 to 20% by volume of the fuel used, rather than a 10% overall maximum as mentioned in the paper.

6. If the system came to replace high-octane motor fuel, would gasoline of about 65-octane number be used? If so, how much more of that grade could be made per barrel of crude than 75- and 85-octane fuel? And how much cheaper?

7. The discussion of Fig. 3* on the SAE alcohol-water injection paper ends with the statement, "This comparison indicates that alcohol-water injection will be of interest with higher-octane fuel, particularly with higher compression ratios."

Not from the economy or convenience standpoints, it won't. Who would want to pay a still higher total fuel bill along with the bother and maintenance of a dual fuel system when paying a premium price for the single fuel (high-octane gasoline) which is high priced precisely because it is made to permit the use of engines of higher power or greater fuel economy by its use alone?

In this connection, note the following comparison from the table in the original paper, Fig. 13.* Comparing operation at 7.25 to 1 compression ratio, lean carburetor jet; with 69.8-octane fuel the bmep at 1200 rpm was 107.6 lb., at 2800 rpm, 96.3 lb. With alcohol-water injection the bmep was raised to 124.2 and 103.8 at 1200 and 2800 with 69.8 fuel; and to 125.6 and 102.8, respectively, with 79.5-octane fuel. Average per cent increase in bmep was 11.6% with 69.8 fuel and 11.7% with 79.5 fuel, or practically a check determination. While the increase due to raising the octane number of the gasoline alone, without alcohol-water injection, was only 5.9% over the speed range, the use of higher octane number fuel along with injection was a waste.

8. In the discussion of Fig. 9*: "It will be seen that in every respect . . . the higher-octane gasoline is best." We found the same thing, only with a more direct bearing on water-injection performance, in studies made in 1934 with water injection in a laboratory engine. The increase in performance and economy went up at a much higher rate, and could be advanced to much higher levels with a given engine, when detonation was suppressed by increasing the

*Figure numbers given here refer to those in the original SAE paper presented in January. Fig. 13 was omitted from the paper as published in NPN's Technical Section.

antiknock value of the fuel itself than when water was added, as shown in Table 1.

9. In the discussion of kinds of alcohols col. 1, page R-88: "The alcohols supply btus to the charge . . . and they also supply some oxygen." This is a chemical blunder; for *combined* oxygen always detracts from rather than adds to fuel efficiency.

10. Specific fuel consumption, not brake thermal efficiency, is the factor to use in comparing *costs*. The work at this laboratory with the commercial alcohol-water injection device showed that the specific fuel consumption (counting the alcohol fraction as part of the fuel consumed) was higher (hence more costly) when alcohol was being injected than when operating on gasoline alone or on gasoline with water injection.

TABLE 1

Comparison of Power Increase with High-Octane Fuel and with Water Injection.

Comp. Ratio	—% Increase in Power with— High-Oct. Fuel	Water Injection
5.0	0	0
5.5	6.0	3.0
6.0	10.5	4.2
6.5	14.8	4.6
7.0	19.0	4.8

11. An essential part of any auxiliary fuel or coolant injection equipment would be a safety device to prevent damage from full-throttle operation in case of failure of the auxiliary liquid supply. This would have to be of 100% reliability, since operation on motor fuel of 10 or more octane numbers lower than the engine's requirement would bring on trouble promptly.

Water Injection Alone Suppressed Detonation But Excessive Engine Rusting Was Found

By L. J. Test

(*Following is a prepared discussion of alcohol-water injection by L. J. Test of the Automotive Laboratory of Atlantic Refining Co., which was presented at a recent meeting of the Philadelphia Section of the Society of Automotive Engineers*):

WE STARTED work on water injection to see its effect on pre-ignition since we had a car that pre-ignited badly on a 76-octane gasoline. An inspection was made of its combustion chamber deposits and they were found to be hard and flaky. A system of water injection was devised. It consisted of another jet installed in the carburetor venturi, a float bowl for the water and a small water tank. Water was fed into the intake mixture at all speeds and throttle openings, its rate being about ¼ that of the gasoline rate. As a result of using the water, the octane requirement of the vehicle was immediately reduced so that a 65-octane fuel could be used without either detonation or pre-ignition.

The car was operated in a normal driving service with alcohol-water injection for about 200 miles, the alcohol being used to prevent the water from freezing. At this time, used oil inspections indicated that the engine was rusting excessively and the experiment was stopped. However, we found that the engine showed no tendency to detonate or pre-ignite on the 65-octane gasoline even with the water-alcohol mixture shut off. An examination of the combustion chamber deposits showed that some of the carbon had been removed and the rest of the deposits altered to a soft, sooty type. The photograph in Fig. 1 shows the carbon formations before and after the water injection.

This led us to try another experiment with a V-8 engine having an octane requirement of approximately 70. A system was connected so that 4 of the 8 cylinders received water injection. At the end of about 200 miles of normal driving and with the water injection shut off the four cylinders that had received the water had a requirement of 51.5 octane while the cylinders that had received no water required about 69-octane fuel to prevent knock.

The water injection was switched to the other four cylinders and after about 200 more miles of driving the requirement of the whole engine was 54.5. Examinations of carbon formations were made before and after these experiments. While the carbon had not been removed to the degree shown in Fig. 1 the nature of the deposits was altered to the soft, sooty type. Here again examination of the used oil and visual inspections of the dip stick indicated excessive rusting.

It should be remembered that in both of these experiments water was drawn into the engine whenever it was running. If it had been injected only at wide open throttle when it was needed to suppress knock it seems reasonable to expect that such a high rate of rusting may not have taken place.

We ran several experiments on our chassis dynamometer in which we found that for a given set of engine adjustments water injection (in rates up to 30%) had no effect on power or fuel consumption provided that engine was not knocking in either case. In an experiment to find how much water could be injected before missing took place, we ran with 140% as much water as gasoline.

It has been stated that alcohol or alcohol and water has advantages over water alone. Some data in our laboratory, while not conclusive, has indicated that while alcohol is more effective in reducing knock for a given rate of injection, water can accomplish the same result if it is used at a high rate. For example, in one case ethyl alcohol injected at a rate of 10% of that of the gasoline reduced octane requirement from 70.5 to 64 while water at a rate of 16% was needed to accomplish the same result. However, in cold weather alcohol should be used to prevent the water from freezing.

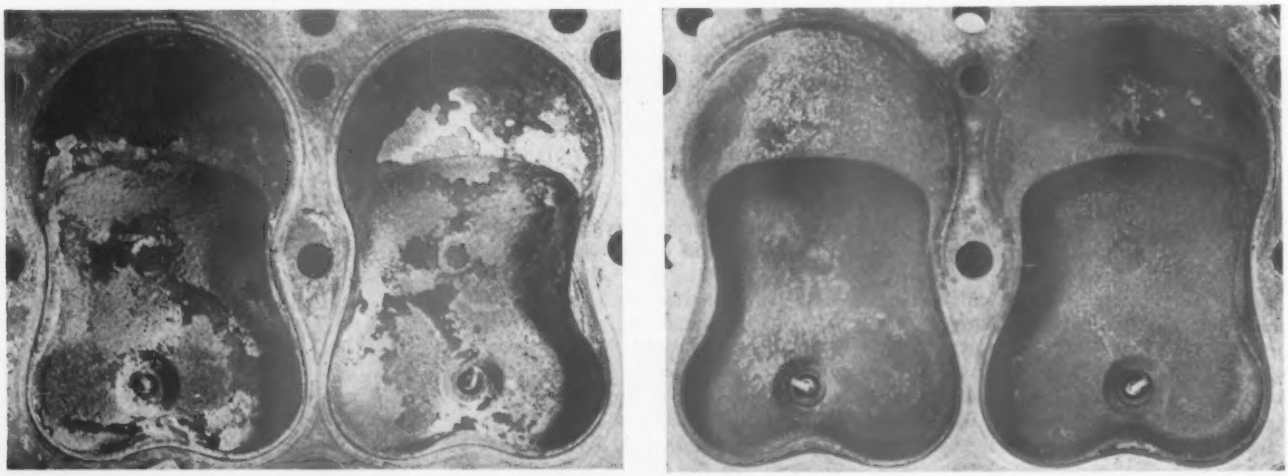

Fig. 1—Left, carbon formations in the combustion chamber before water injection; right, after 200 miles of water injection

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Evaporation Losses of Aviation Gasoline in Standing Storage

PART 1—Tests with Blended Aviation Gasoline

By Peter Grandone

In this report, hitherto restricted because of military necessity, the Bureau of Mines details a series of investigations into the extent of evaporation losses from aviation gasoline standing in storage over a period of months. The data given are the first to be published in connection with the storage of this modern petroleum product.

The author discusses the effect of evaporation losses upon the characteristics of finished aviation gasoline, as well as on two blending components, when stored in either cone-roof or breather-roof tanks of 55,000 bbls. capacity. It is shown that losses from both types of tanks are relatively small, but greater from cone-roof tanks. Laboratory tests reveal that neither chemical nor physical characteristics of the products were appreciably affected during the storage periods.

The report is presented in two parts. Part 1 details the investigations on blended aviation gasoline. Part 2, to be published next month, is concerned with the blending agents neohexane and isooctane.

THE Bureau of Mines, recognizing the importance of knowing the evaporation losses of aviation gasoline as larger quantities of this material must be stored, has made studies at a large refinery in the Texas Panhandle area during the past 18 months to determine the magnitude of the losses, by evaporation, under different storage conditions. Proper storage of aviation gasoline is very important, not only because large supplies are being stored for military use but because the specifications to which this fuel must conform are very rigid.

Aviation gasolines that conform to present-day specifications are blended from base-gasoline stocks (in some instances relatively pure hydrocarbons), each of which has different physical and chemical characteristics. Consequently, partial loss of any one of the more volatile components from the blended fuel results not only in material loss of the blended fuel but also may affect the characteristics or performance of the gasoline.

One characteristic that has considerable influence on the vaporization tendency of gasoline is vapor pressure. Although the vapor pressure of aviation gasoline usually is lower than that of average commercial motor fuel, the quantity of certain components having relatively higher vapor pressure is greater in aviation gasoline, so that under prolonged storage the evaporation loss of these components may be appreciable.

The results of evaporation-loss studies described in this report represent data obtained from the storage of approximately 150,000 bbls. of blended aviation gasoline and of approximately 200,000 bbls. of two special blending stocks for aviation gasoline. These fuels were stored in seven 55,000-bbl. steel tanks of the cone-roof and breather-roof types. All storage tanks had light painted surfaces for maximum heat reflection, and two had water sprays on their decks for additional cooling during the summer.

Evaporation is known to proceed at a rate depending on well-defined physical laws, so that under identical conditions the rate of loss will be the same. The factors that influence the rate of evaporation of a given volatile liquid are temperature of the liquid surface, concentration of vapor in the atmosphere in contact with the liquid, and area of the evaporating surfaces.

If other conditions remain unchanged, the rate of evaporation of a volatile liquid in a storage tank will be influenced by two factors. The first is the vapor pressure of the liquid; this is a force or physical characteristic of the liquid itself that varies with the temperature of the liquid surface and governs the concentration of gasoline vapor at a given temperature in the vapor-air mixture above the liquid surface.

The second factor is "breathing" of the tank through the roof vents. Breathing is the expulsion of vapor-air mixture from the tank during certain periods of the day and the inflow of air from the atmosphere at other times. Breathing is caused principally by normal temperature variations. Therefore a vapor-tight cone-roof tank is breathing most of the time, whereas a tank equipped with a breather roof provides a variable vapor space and eliminates part of the breathing by the raising and lowering of the roof as the vapor expands and contracts. Were it not for breathing of the tank, the air above the liquid eventually would become saturated with gasoline vapor at the temperature of the vapor-air mixture and at the vapor pressure of the liquid, and further evaporation would cease until these conditions changed.

Breathing of storage tanks due to wide temperature variations in the air-vapor mixture above the liquid may be greatly reduced by the use of water sprays or water seals on the tank roofs, by insulation and sunshades, (1) by the use of light-color paints on the tank surface, (2) and by the use of pressure- and vacuum-relief valves in various combinations with the above methods. (3)

Method of Determining Evaporation

The evaporation losses herein reported were determined by the direct gaging method, which consists of measuring the liquid level periodically in a storage tank as evaporation proceeds. The tests were conducted on seven 55,000-bbl. tanks containing aviation gasoline in standing storage. Thus, the conditions for this study and particularly this method were most ideal, inasmuch as no transfer of fuel to or from the tanks occurred during the test periods.

Measurements of the fuel in each tank at the beginning of the test and at periods approximately one month apart thereafter were made by lowering a steel gaging tape through the gage hatch to bottom, using care to gage each time from the same selected point on the rim of the hatch.

To obtain a sharp indication of the gasoline level on the steel tape, it was necessary to apply a very thin film of steam-cylinder lubricant for a few inches above and below the anticipated reading point on the tape. The lubricant of course dissolved off the immersed section of the tape readily, leaving a clear line for reading. With reasonable care it was found that gages could be checked repeatedly to 1/16-in. on the steel tape, which in a 55,000-bbl. tank, represents only 9.5 bbls.

Because these storage tanks carried about 6 in. of water seal on the bottom to indicate any leakage through the bottom plate seams it also was necessary to gage the water by applying a thin film of water-soluble colored soap on the plumb bob at the end of the tape.

Observed gage readings in feet and inches were converted to volume readings in barrels by referring to the tank tables furnished by the manufacturer

The accompanying article is the first section of the U. S. Bureau of Mines Report of Investigations 3701, "Evaporation Losses of Aviation Gasoline in Standing Storage." Peter Grandone is Associate Petroleum Engineer, Bureau of Mines, Petroleum Experiment Station, Bartlesville, Okla. The second section of the report will be carried in a later issue of the NPN Technical Section.

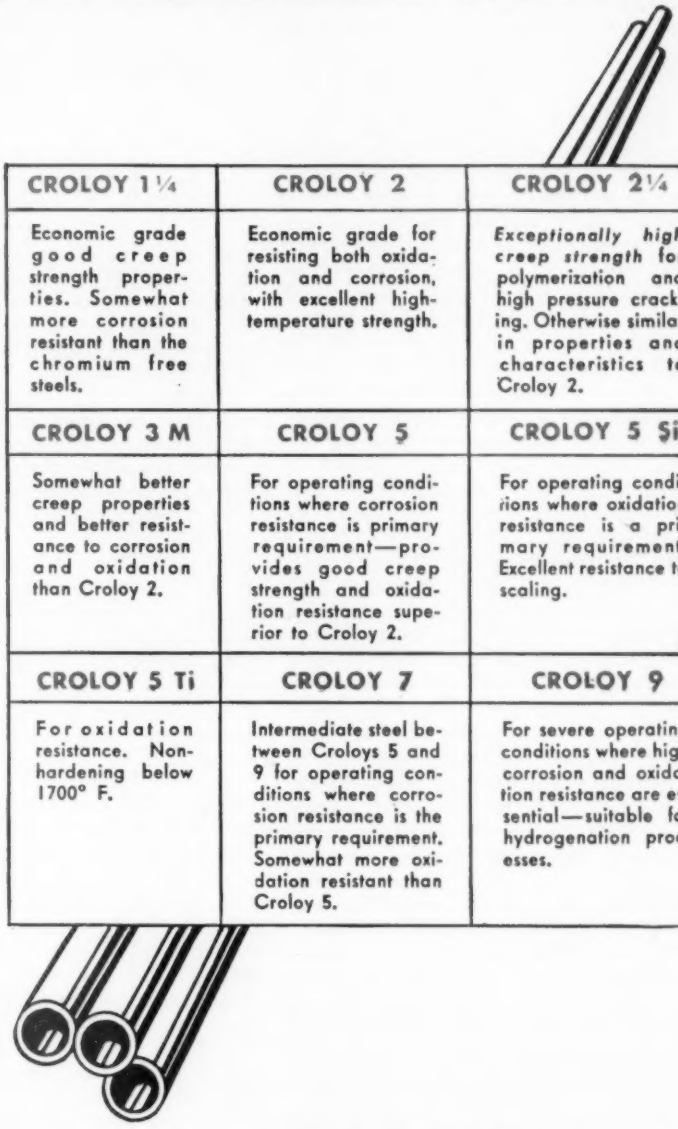
FOR TUBING TO MATCH EACH CORROSIVE ATTACK

In the wide range of Croloy steel alloys developed by Babcock & Wilcox, there are types that make possible a close match between refinery tubing and the job conditions it must face.

The kind of corrosive attack to be resisted may be one of several types. Its primary cause may be high temperatures, in which case oxidation also must be specially guarded against. It may have its origin in contaminents or corrosive agents in the crude or gases being handled. Conditions encountered in processing may be its source, with the action of catalysts setting up reactions which tend to corrode or carburize tubing.

Among the Croloys listed in the panel and others in ferritic and austenitic stainless alloy steel types—covered by the B&W Croloy stainless steels—there are materials from which the one best tubing may be selected for each of your diverse refinery needs. Data on creep strength, tensile strength, and physical properties are available to complete the background for your decision.

Further help is also at your disposal. Through long associations with many branches of the petroleum industry, B&W engineers are well qualified to recommend the grade of tubing you need. When you call on Croloy, call on their advice and assistance.



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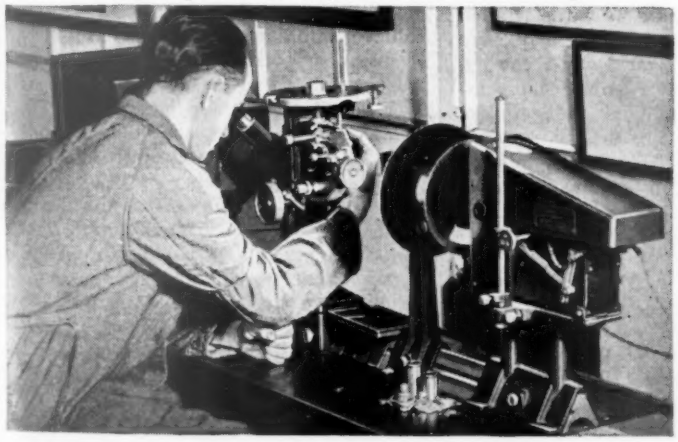
Economic grade good creep strength properties. Somewhat more corrosion resistant than the chromium free steels.	Economic grade for resisting both oxidation and corrosion, with excellent high-temperature strength.	*Exceptionally high creep strength* for polymerization and high pressure cracking. Otherwise similar in properties and characteristics to Croloy 2.
CROLOY 3 M	**CROLOY 5**	**CROLOY 5 Si**
Somewhat better creep properties and better resistance to corrosion and oxidation than Croloy 2.	For operating conditions where corrosion resistance is primary requirement—provides good creep strength and oxidation resistance superior to Croloy 2.	For operating conditions where oxidation resistance is a primary requirement. Excellent resistance to scaling.
CROLOY 5 Ti	**CROLOY 7**	**CROLOY 9**
For oxidation resistance. Non-hardening below 1700° F.	Intermediate steel between Croloys 5 and 9 for operating conditions where corrosion resistance is the primary requirement. Somewhat more oxidation resistant than Croloy 5.	For severe operating conditions where high corrosion and oxidation resistance are essential—suitable for hydrogenation processes.

Searching for Better Alloys to Give You Better Tubing



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with each tank; then they were corrected from observed temperature to a base temperature of 60° F. by references to the National Standard Petroleum Tables (4). The observed gages also were corrected for thermal expansion of the steel tank and of the steel tape from observed temperature to 60° F., using the correction 0.655 bbl. per °F. of temperature change on a 55,000-bbl. steel tank. Observed temperatures of the tank shell and steel tape were assumed to conform with the observed temperature of the contained fuel.

Accurate measurement of the fuel temperature in a storage tank is most important in connection with the direct gaging method for determining evaporation losses because the thermal expansion of gasoline is about 0.06% per °F. However, if enough observations of the liquid level are made over a period of time and the data are plotted on cross-section paper a suitable curve can be drawn through the data points, even though a few points may fall out of line.

In these tests the observed temperature of the fuel was obtained as the average of three measurements taken in a vertical line below the gage hatch. The three measurements were taken separately by lowering a special "thief" (closed-cup) thermometer from the usual gaging point to a point 5 feet below the liquid surface, a point midway between the liquid level and the bottom of the tank, and a point 5 feet above the tank bottom. It was not practicable to measure the temperature from other points on the tank roof because only one gage hatch was provided on each tank.

Methods for measuring the evaporation losses of liquid fuels that involve change of physical characteristics, such as gravity and vapor pressure, were not feasible for this study because the materials being tested (particularly in tests D, E, F, and G) consisted of substantially pure hydrocarbons having a narrow distillation range. Therefore, the physical characteristics of the fuels did not change sufficiently with evaporation to permit correlation between evaporation loss and change in any one of the characteristics.

Other methods available, such as continuous measurement of the volume and composition of the vapor-air mixture expelled from a tank, were considered subject to appreciable errors because of the difficulties of measuring the volume of vapor-air mixture expelled and the continuously varying concentration of gasoline vapor in the mixture.

Three evaporation-loss tests were conducted on blended aviation gasoline in standing storage from Jan. 21 to July 15, 1942. Test A was on a 55,000-bbl. tank equipped with a cone roof and tests B and C on 55,000-bbl. tanks equipped with modified breather roofs. A meteorological summary covering each test month is given in Table 1.

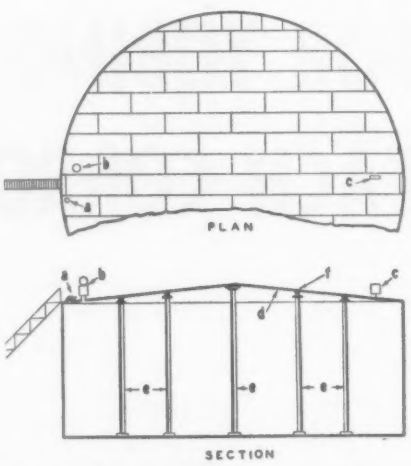


Fig. 1 (above)—Cone-roofed storage tank of 55,000 bbls. capacity, used in Test A. The symbols indicate the following: a—gage hatch, b—pressure- and vacuum-relief valve, c—recording thermometer, d—rafters, e—columns, f—cone roof

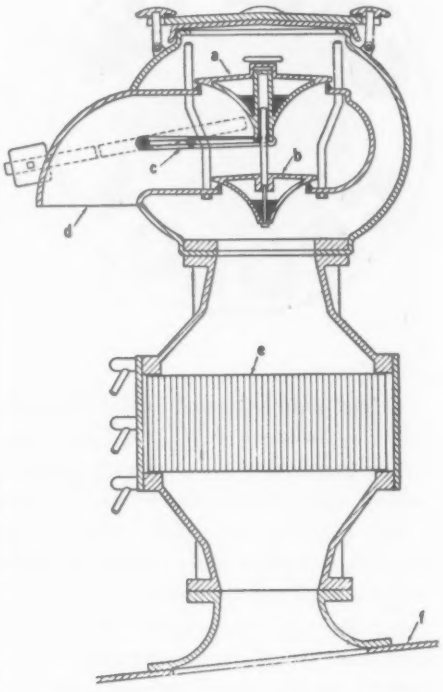


Fig. 2 (right)—Pressure- and vacuum-relief valve and flame arrestor, showing, a—vacuum-relief valve, b—pressure-relief valve, c—flame snuffer, d—vent, e—flame arrestor, f—tank roof

Test A—Tank With Cone Roof

A diagram of the storage tank used for Test A is shown in Fig. 1. It is constructed of steel plates with riveted seams on the side shell and welded seams on the roof. The height to the chime is 30 ft., diameter 114.4 ft., and capacity 55,000 bbls. when filled to the chime. The fixed cone roof *f*, which is supported on a series of steel columns, *e*, has a pitch of 0.5-inch rise per foot. Thus, the volume (vapor space) of the cone roof independent of the tank is approximately 8,000 cu. ft.

Auxiliary equipment on the roof consists of one 8-in.-gage hatch *a*, one 8-in. all-aluminum vent unit *b*, with enclosed pressure- and vacuum-relief valves and flame arrester, and one 7-day recording thermometer *c* for recording temperatures of the vapors above the gasoline. The paint on the tank surface is white for maximum heat reflection, but no water spray is used for cooling.

A drawing of the vent unit is shown in Fig. 2, and it is through this vent that the tank "breathes", as the vapor-tight gage hatch is opened only during gaging and sampling. The pressure- and vacuum-relief valves in the vent unit were adjusted to open at 0.5 oz. per sq. in. pressure differential above and below atmospheric pressure, respectively —the pressure limits considered safe to prevent damage to the tank roof.

When the pressure of the vapors in the tank exceeds 0.5 oz. per sq. in., valve *b* (Fig. 2) is lifted off its seat, permitting the vapors to flow out through vent *d*; when the pressure of the tank is lowered 0.05 oz. per sq. in. below atmospheric, valve *a* is lifted off its seat, permitting air to flow in through vent *d*. Lever *c* is a "flame snuffer," which is operated manually to hold valve *b* closed should the vapors issuing from the vent become ignited. The bank of plates or separators comprising the flame arrester (*e* in Fig. 2) also acts as a condenser and is arranged to facilitate drainage of entrained condensate back into the tank.

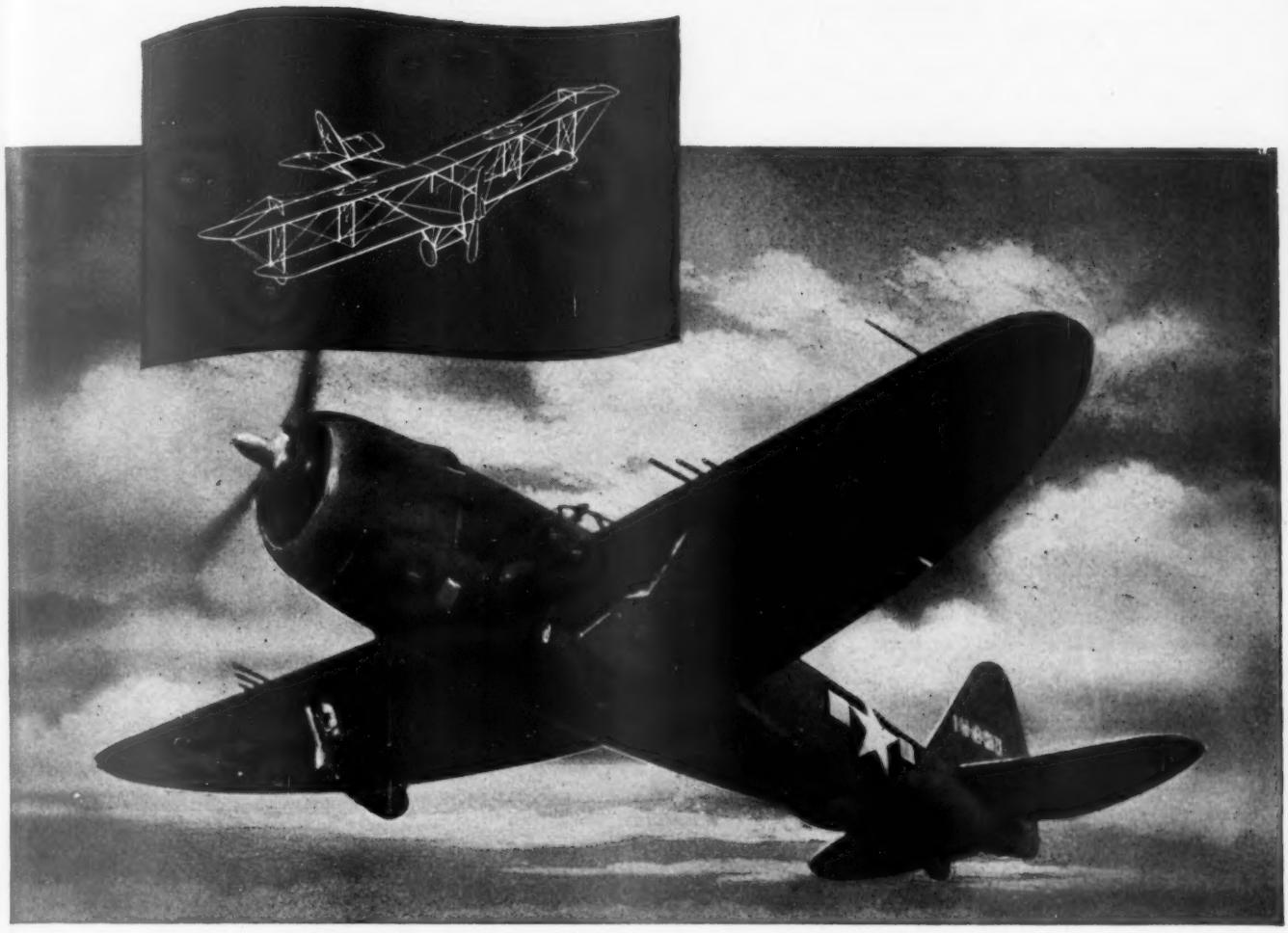
The evaporation-loss results obtained from tank A were observed on 50,757 bbls. (initial measurement corrected to 60° F.) of blended aviation gasoline held in standing storage over the period beginning Jan. 21, 1942, and ending July 15, 1942. The losses were observed periodically at about 30-day intervals and are presented cumulatively in curve *A*, Fig. 3. The curve shows that the evaporation loss sustained over the entire test period amounted to 470 bbls. or 0.93% of the volume stored. The rate of evaporation from the beginning of the test to June 1 was about 65 bbls. or 0.13% per month and then increased to about 123 bbls (0.24%) per month for the remainder of the test period.

Results of laboratory test on samples

TABLE 1—Meteorological Summary for January-July 1942*

Month	Jan.	Feb.	March	April	May	June	July
Mean maximum temperature, °F.	49.2	51.0	58.5	68.1	77.8	86.6	91.2
Mean minimum temperature, °F.	20.4	22.8	29.5	44.3	49.2	62.2	65.1
Maximum temperature, °F.	71	70	79	87	95	103	99
Minimum temperature, °F.	—5	0	18	30	33	49	55
Precipitation, total inches	.06	.63	.42	3.74	.91	2.29	.80

*Data supplied by U. S. Weather Bureau, English Field, Amarillo, Tex.



P-47 COULDN'T FLY ON JENNY'S OIL

Vastly improved lubricating oils help today's fighting planes to operate at speeds and altitudes impossible for the doughty JN of World War I. Closer tolerances, heavier bearing loads, and higher operating speeds in plane engines—and other machines—could be specified only as refining research and technique made oils of the necessary quality available.

One sure way to achieve superior quality in lubricating oil is percolation through selected adsorbents. In fact, modern percolation gives oil certain quality specifications that are difficult for other methods to match. Percolation finishing assures high viscosity index, better oxidation stability and color stability, lower carbon residue, and better demulsifying characteristics.

The percolation process costs less, too. The adsorbent can be regenerated by burning off the accumulated tarry material and used over and over again. Special oils can be produced with only slight variations from routine operation.

Refiners who intend to expand present facilities or to rebuild plants in liberated countries will want to study the latest developments in modern percolation finishing before approving final plans. We have the facts and figures.

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R-255

TABLE 2 — Laboratory Analyses of Aviation Gasoline Samples Obtained at Beginning and End of Test Period on Tank A

Test	Tank A	
Date sampled	Jan. 21, 1942	July 15, 1942
Specific gravity at 60° F.	0.6948	0.6964
A.P.I. gravity at 60° F.	72.1	71.7
Reid vapor pressure, psi	6.7	6.7
Octane No. (A.F.D.-1-C) clear	80.7	79.7
Sulfur content, %	.003	.005
Color, Saybolt	30+	30+
Corrosion (Copper - dish method)	Neg.	Neg
A.S.T.M. distillation, D-86		
F. D., °F.	116	126
10%, °F.	139	151
20%, °F.	146	154
30%, °F.	153	156
40%, °F.	161	164
50%, °F.	171	172
60%, °F.	184	183
70%, °F.	199	198
80%, °F.	217	217
90%, °F.	244	245
E. P. °F.	352	360
Recovery, %	98.0	98.5
Residue, %	1.1	.8
Loss, %	.9	.7

of the stored fuel taken at the beginning and end of the test on tank A are presented in columns 1 and 2, respectively, of Table 2. These determinations include specific gravity, Reid vapor pressure, octane number by the A.F.D.-1C method (no concentration of tetraethyl lead), sulfur content, color (Saybolt), corrosiveness by the copper-dish method, and distillation by the A.S.T.M. D-86 method, and were made to show the effect of the storage time on the characteristics of the fuel.

Comparison of the results obtained at the beginning and end of this test indicates no appreciable changes in the fuel characteristics over the entire storage period, although a slight effect caused by the evaporation loss is noticeable in the specific or A.P.I. gravity of the fuel and in distillation temperatures from the initial to the 20% point. Gravity decreased from 72.1° to 71.7° A.P.I., and distillation temperature increased 10°, 12°, and 8° F. for the initial, 10%, and 20% points, respectively. Other small differences probably fall within the limits of laboratory accuracy.

Because the fuel stored in tank A was considered a comparatively stable blend, the evaporation loss that occurred during the entire test period probably would not be expected to have any appreciable effects on gravity or distillation temperature. The blended fuel contained no tetraethyl lead during the storage period; therefore no tests were made on tetraethyl lead concentrations.

Tests B and C—Modified Breather Roofs

A diagram of the breather-roof tanks used in Tests B and C is shown in Fig. 4. These tanks have the same dimensions and constructional features as the cone-roof tank shown in Fig. 1 but are provided with modified breather-type roofs.

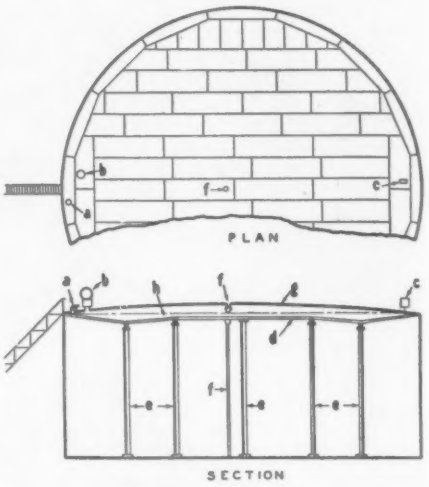

Fig. 4—55,000-bbl. storage tank with breather roof, used in Tests B and C. Symbols indicate: a—gage hatch, b—pressure- and vacuum-relief valve, c—recording thermometer, d—rafters, e—columns, f—water drain, g—breather roof in inflated position, h—breather roof in normal position

The modified breather roof may be described as a flexible steel diaphragm across the top of a storage tank and welded at its periphery to the top of the tank shell. Construction is of 3/16-in. steel plates with welded seams. The roof in its normal position rests on a framing of rafters (*d*, Fig. 4) and girders, which are supported by a series of columns, *e*. The rafters in the outer circle slope downward a total of 10 in. from the chime; the remaining rafters are set about 3 in. below the level of the tank chime and have a slight pitch toward the center to facilitate drainage.

Because the roof is not attached to the framework support, it is free to flex up and down as the air-vapor mixture in the tank expands and contracts. When fully expanded, the roof assumes a dome shape, with its center 12 in. above the rafters, thereby increasing the volume by approximately 8,000 cu. ft. in a 55,000-bbl. tank.

The value of a breather roof in reducing evaporation losses is illustrated by comparing it with a tank equipped with a fixed conical roof having a pitch of 0.5 in. per ft. Referring to Test A, for example, the 55,000-bbl. cone-roof tank illustrated in Fig. 1 contained gasoline to within 13 in. (highest gage) of the top which, according to the tank table, means that 10,000 cu. ft. of vapor space remains from the surface of the liquid to the tank chime. Therefore, the total vapor space in the tank, including the roof, was approximately 18,800 cu. ft.

Inasmuch as the daily temperature variation averaged about 40° F., the increased volume of the vapors due to

(*Continued on p. R-318*)

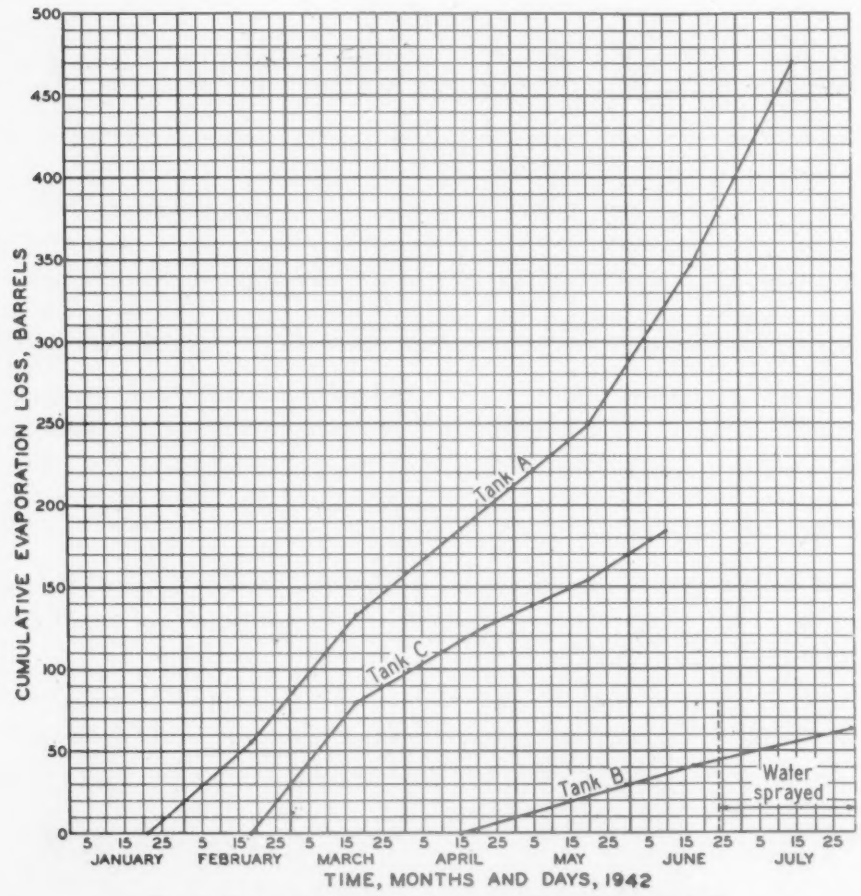

Fig. 3—Evaporation losses from Test Tanks A, B and C

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New Devices Save Time and Labor In Setting Up Engine Test Stands

Oil Company's Automotive Laboratory Built for Efficiency; Features Devised by Technical Staff Include Automatic Control of Crank Case Oil Level and Central Battery Charger; Service and Dynamometer Installations Quickly Adaptable to Various Test Units

THE "House of Ideas" is how Sun Oil Co. characterizes its new centralized Automotive Laboratory, recently put into operation at the company's Marcus Hook, Pa., refinery.

Built and equipped during a period when materials and manpower are hard to get—even with a priority—ingenious ideas have played an important part in putting the laboratory on a smooth-running basis. Included among the time and labor savers the laboratory's technical staff has devised are:

Service and dynamometer installations which require a minimum of changes to accommodate a variety of test units.

An oil reservoir arrangement which maintains a constant level of oil in the crankcase of the multi-cylinder test engines.

A central battery charger with leads running to each dynamometer stand, permitting recharging of batteries while they are still in position.

Sun has had facilities for testing its various products in the past—but they were scattered all over the refinery. When the production of critical aviation gasoline and lubricants and of heavy-duty oils began increasing by leaps and bounds (Sun's new $7,000,000 solvent lube oil plant was completed last fall), the need was finally recognized for a central evaluation center where these products could be checked and tested in a coordinated manner. The new automotive laboratory is the result.

Purpose of the new "lab" is primarily to perform research testing of new products, to evaluate them in terms of what they will and will not do. It is the proving ground for testing in actual engines the new ideas in fuels and lubricants originated by other development sections of the Sun organization.

At the present time the products being tested are strictly "wartime"—aviation engine oils, heavy-duty oils, aviation gasoline. About two thirds of the work is concentrated on lubes, and the remaining third on aviation fuel, with very little if any work being done at the present time on civilian motor fuels.

Checking and testing aren't the sole functions of a laboratory, and Sun's automotive laboratory has two other secondary but important duties, in addition to those just outlined.

Other Laboratory Functions

First, its engineers keep in close touch with what is going on in the way of engineering developments in the various fields of automotive activity—direct fuel injection for gasoline engines, supercharging, water injection, gas turbines, dual-fuel Diesel engines, to mention a few. By analyzing the individual developments and weighing their potentialities, the automotive staff tries to anticipate the requirements that will be created within the next few years for new fuels and lubricants. In this way it is able to advise the company of likely demands for new products.

Second, there is the everlasting work of improving old methods and developing new and better ones for testing both machines and oil products. Without reliable and reproducible test methods, no laboratory can function properly.

Keynote of the new laboratory is simplicity and flexibility, combined with complete adequacy. It has been built and equipped for efficient operation, so that its engineers could turn out good work fast.

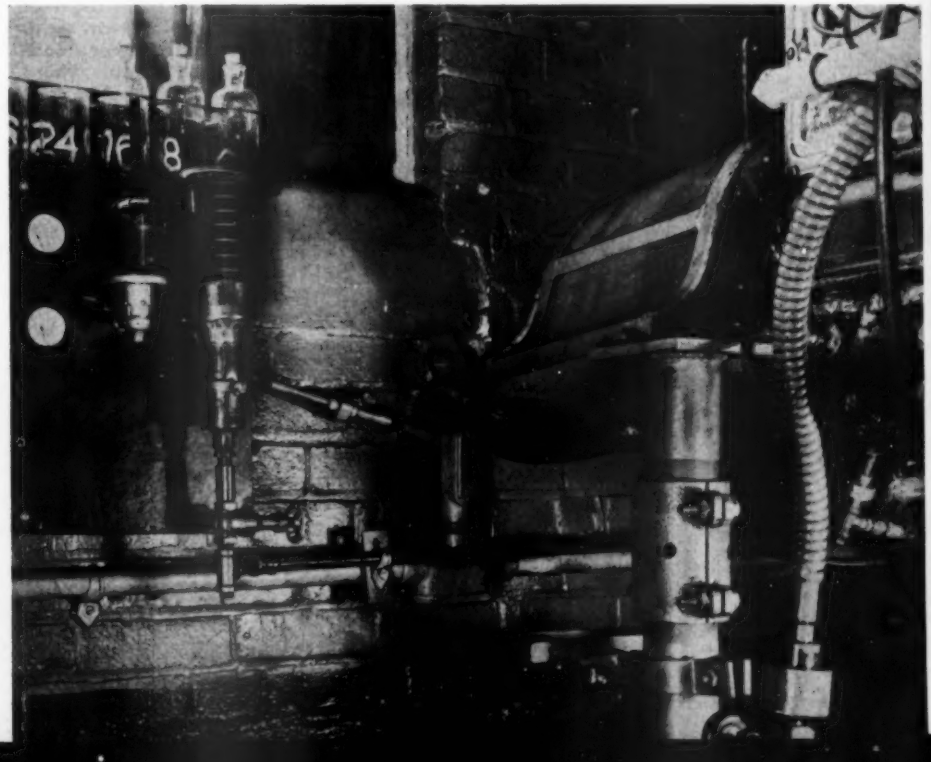
From the outside, the laboratory isn't impressive. It's not a new building—priorities prevented that. It's a remodeled one-story, L-shaped brick structure, which formerly served as a garage and warehouse.

The main portion of the building, approximately 60 by 40 ft., houses most of the usual automotive testing equipment. This includes a battery of six single-cylinder Lauson test engines, three multi-cylinder test stands adaptable for a variety of engines, two Co-operative Oil Test units, and a machine and repair shop for overhauling the various units and fabricating experimental equipment.

In a wing off the main building are two smaller testing chambers, one housing a single-cylinder Caterpiller Diesel test engine and the other a high-octane aviation gasoline test unit. Also in the wing are a cleaning room, containing a large tank in which an entire engine can be submerged for removal of oil and grease; a spare test chamber, now used for storage; and a garage, where Sun's test fleet of six cars is serviced and checked.

The original building that now houses the laboratory had no basement, other than a small boiler room under one corner. When Sun took it over, they excavated under the main building to make a full basement. This is now used for storage, and also includes a photo studio and darkroom, several motor-generator sets for supplying DC current, and a central battery recharger.

Much thought and attention was given to the layout of the permanent installations in the Sun laboratory, including,



Designed for efficiency, Sun's new automotive laboratory at Marcus Hook, Pa., employs a number of devices for saving time and labor. Typical of these is a system for maintaining constant oil levels in the crank cases of multi-cylinder test engines, pictured at the right. The large bottle feeds directly into the crank case. The smaller bottle supplies lubricants to the bearings of the dynamometer fan located outside the main building in a sound proofed housing

A. Ludlow Clayden is Sun's chief automotive engineer at the new laboratory and instigator of many of the ideas that have increased its efficiency. His own "pet invention" hangs on the wall behind him — a compass card divided into eight individually illuminated sectors. The wiring from each sector is connected to a weather vane on top of the building in such a manner that one sector is always lighted, indicating the direction of the wind. "With that indicator and this recording barometer on the table," says Mr. Clayden, "we can always tell whether we'll need our rubbers tomorrow."

for the most part, the service lines and dynamometer beds.

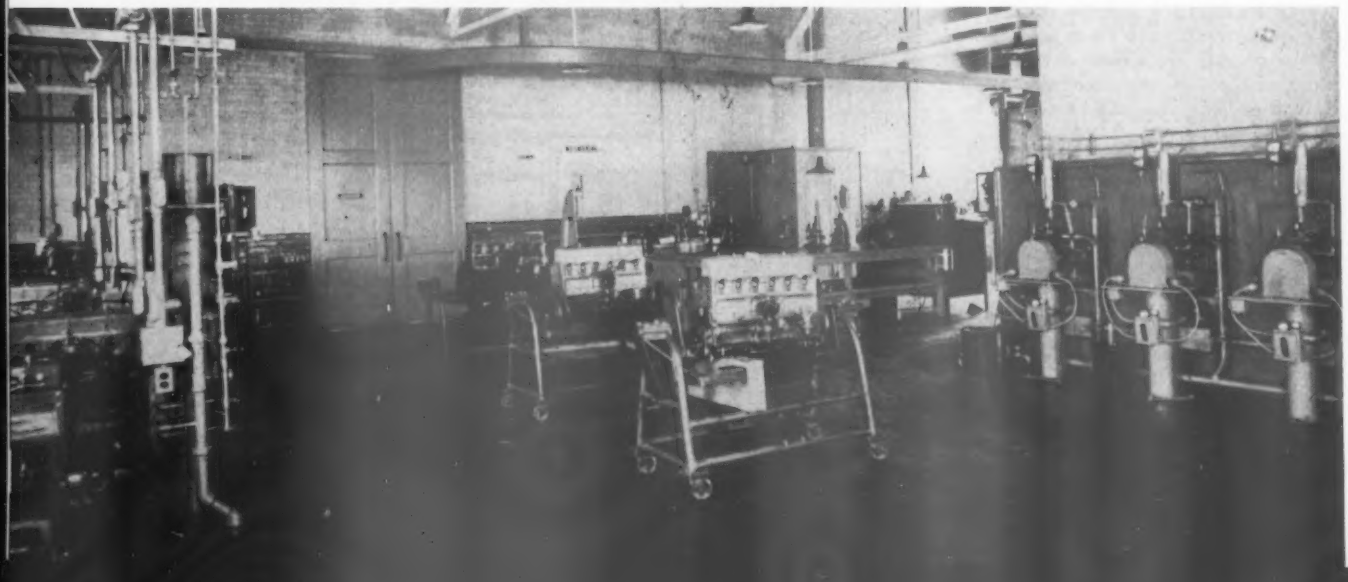
Quite a variety of services are necessary in an automotive laboratory—fuel, electricity, air, water, exhaust, drainage. Taken all together they involve a considerable mass of piping and wiring, and arranging them so that they can be conveniently attached for a variety of engines presents quite a problem.

Many methods of installing these services have been tried in laboratories in the past. The most attractive, from a strictly appearance viewpoint, is to have all of the lines under the floor and out of sight. This is an excellent arrangement for a permanent setup, but involves annoying inconveniences when it becomes necessary to install new equipment.

The opposite method is to have everything overhead, which is probably the best design for complete adaptability. But it has two primary disadvantages: First, it involves a tremendous mass of piping hanging from the ceiling and walls; second, it poses complication with regard to exhaust.

Nearly all standard engines have manifolds which direct the exhaust in a downward direction. If this has to be turned around and led straight upward to an overhead outlet it makes for complicated piping at the floor level. In addition, a very large amount of heat is thrown into the building, and the presence of a large number of nearly red hot exhaust pipes is a hazard from both the fire and safety viewpoints.

Still a third system of installing service lines is to have gutters or troughs in the floor, covered with steel plates or grids. Such a system makes all piping



General view of the main room at Sun's laboratory. In the rear, right, is the shop where small experimental parts are fabricated and where test equipment is overhauled and adjusted. Overhead track in background leads to cleaning room

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This is a high-wire artist. His very life depends on hair-trigger response to the slightest disturbance of balance. The same principle applies to any industrial process in which conditions of temperature, pressure or flow are subject to frequent variation. A process disturbance that isn't detected and corrected soon enough passes along to other parts of the process, finally upsetting product uniformity.

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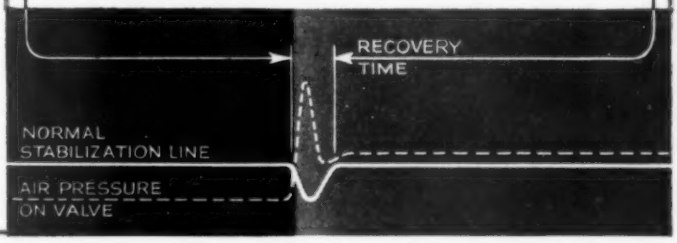

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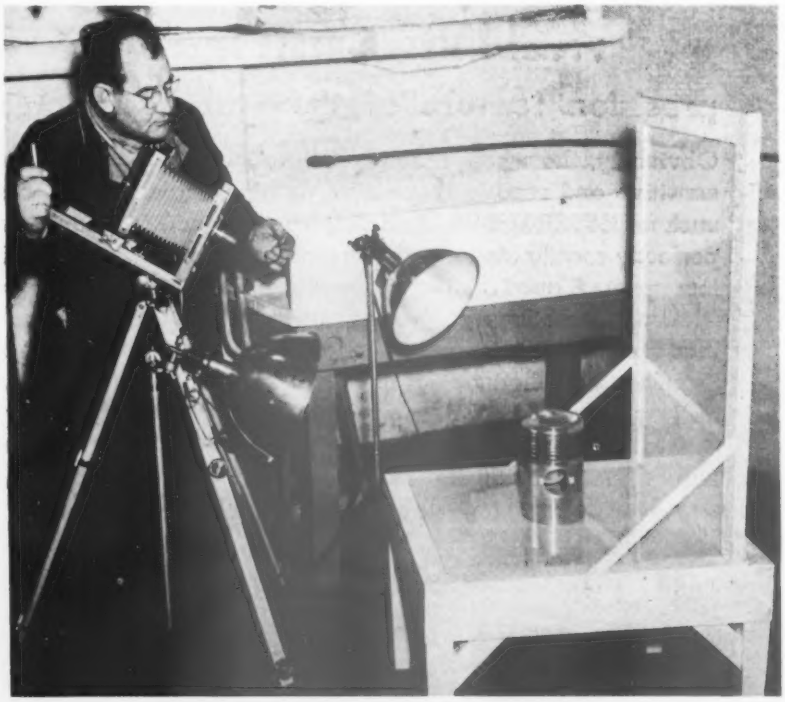
ABOVE—Bank of multi-cylinder test stands in the Sun laboratory. Absorption fans are used as dynamometers for these units; the fan shafts extend through the wall of the building, the fans being housed in felt-lined, sound proofed houses just outside

BELOW—Permanent records of all tests are kept in the form of photographs showing the condition of the engine parts after every test run. A set-up such as the one shown below is used to assure standardized pictures



accessible, but not always conveniently so. Furthermore, these gutters are difficult to keep clean and they serve as a trap for all sorts of combustible material.

In designing the layout of the Sun Oil Co.'s laboratory, a combination of all three methods has been worked out. Based on the fact that the dynamometer beds are fairly permanently located and that, as a consequence, certain services will remain in a relatively static position, some service lines have been put underground and others overhead.

The exhaust lines are carried under the floor, with several alternate outlets provided at floor level for each dynamometer. Also beneath the floor and set in concrete are drain lines, used mainly for overflow cooling water, and a vacuum line, for removal of oil fumes from the engine crankcases. The exhaust and vacuum lines lead to the bottom of a single steel stack, located centrally in the building. The main electrical conduits to the larger dynamometer are also underground.

Overhead, and mostly on ceiling hangers, are gasoline, water, steam and compressed air supply lines. Duplicate gasoline lines are provided so that two different fuels are available at any engine position. The gasoline system is fed by gravity from two small tanks, which are kept at a controlled level by electric pumps drawing from underground tanks outside the building. When it is necessary to use fuels other than the two regular supplies, conventional arrangements are made at the engine. An additional electrical supply line is also brought in overhead—110 volt A.C., for use at the control board for automatic thermostats and for recording temperatures, speeds and pressures.

Cold water is fed into the exhaust connection of every engine, permitting the actual connection between the engine and the exhaust line to be made with rubber hose. Such a connection has two advantages over any type of rigid or solid coupling—adaptability and flexibility. Its adaptability makes it much easier to hook up a variety of engines without necessitating any major alterations in the connection. Its flexibility absorbs engine vibrations which would very likely cause trouble with a solid metal connection. So efficient is this exhaust cooling system that no part of the exhaust lines ever becomes dangerously hot to touch.

For power absorption, three systems are in use. One, a direct current system for cradle type dynamometers; the second, A.C. dynamometers, requiring only a small supply of D.C. exciting current; and the third, which is employed rather generally, absorption fans for making runs under standard conditions, as, for example, the standard Chevrolet test for heavy-duty oils.

A fan is much simpler than an electrical unit and, Sun's engineers claim, is

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SOLVENT DEWAXING PROCESS *are:*

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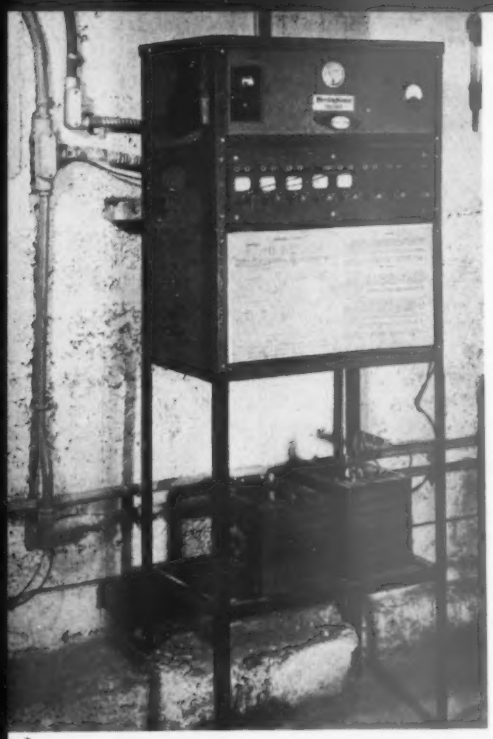

A central battery charger in the basement of the laboratory is connected directly to each dynamometer stand. This set-up permits recharging the batteries while they are still in position at the test stand, saving time and labor

just as reliable once it has been carefully calibrated. In the case of the larger units, such as the multi-cylinder test engines, the engine coupling extends through the outer wall of the building and each fan is outside of the building and in an individual felt-lined house. This arrangement makes for less noise and draft.

As a safety precaution each fan shaft is equipped with a simple mechanical overspeed device which can be set to cut the ignition at any predetermined speed. Safety devices of this sort are used wherever possible on engines which run for relatively long periods on a schedule calling for only occasional attention from the operators.

As a time and labor saver, the conventional starting motors on each test engine are mounted independently of the engine itself, so that they do not have to be removed and later replaced at each engine overhaul. The fan absorbers incorporate the starting motors on flywheel rings, and the A.C. dynamometers are equipped with ring gears that are geared to the starting motors.

A battery charger in the basement of the laboratory is wired through a control panel directly to each dynamometer test stand. With this setup it is thus possible to recharge any battery while it is still in position on the test stand, instead of having to remove it to the charger.

Another device to save time and make for more efficient operation is a system for maintaining constant oil levels in the crank cases of the multi-cylinder test engines. Each crank case is connected by piping with an external reservoir, which is kept filled to the proper level by an inverted quart bottle of the proper lubricant. The neck of the bottle extends just slightly below the desired reservoir level. Whenever that level, because of oil losses in the engine, falls enough to expose the neck of the bottle, air will enter the bottle and displace enough make-up oil to bring the reservoir back up to the proper level.

The inverted bottle of make-up oil is calibrated so that the oil consumption of the engine can easily be determined without the necessity of measuring the oil level in the crank case.

The attempt has been made to provide most of the engine beds with a cooling system and control unit readily adaptable to a fair variety of engines. This control unit, in the case of the multi-cylinder test stands, carries the panel board to which all the main services are brought. This means that to change engines it is only necessary to change the connections between the panel unit and the engine itself.

Considerable room has been left for future expansion of the laboratory. As pointed out before, there is one spare test chamber which can still be equipped. In addition, the large dynamometer beds in the two individual test chambers are double ended so that one engine can be set up and prepared for a test run at one end while the dynamometer is being operated from the opposite end. Only one test engine is in use on each bed at the present time, but a second one could easily be added, permitting changes to be made in a very short space of time and greatly increasing the number of tests which could be run.

Sun Oil Co. doesn't claim that its new laboratory is the biggest, most costly or most elaborate in the world. They do believe it to be, however, in the words of Ludlow Clayden, chief automotive research director, "just about the most *efficient* of any belonging to anyone, either in the oil industry or any other allied business."

The large dynamometer stands are doubled ended, so that one engine can be set up and prepared for its test run at one end while a second engine is being operated at the other end. Only one engine is in use on this stand at the present time—a single cylinder Caterpillar Diesel unit

The Production of Isoprene By Catalytic Dehydrogenation

By Julian M. Mavity and Earl E. Zetterholm

The growing importance of isoprene in the synthetic rubber and other commercial fields is recognized. A selective method for producing isoprene by catalytic dehydrogenation of petroleum stocks comprising either isopentane, isopentenes, or mixtures of these components, is described. U.O.P. commercial dehydrogenation catalyst is employed. Recycle yields up to 80% or higher are indicated, depending on the conversions and conditions of operation. The process is preferably conducted at reduced pressure, at temperatures of about 615-660° C.

ISOPRENE, the basic unit of natural rubber, is gaining noteworthy importance in the synthetic rubber field. Its utilization as a constituent of butyl rubber[1] in all probability foreshadows other future applications.

The retarded development of commercial uses for this hydrocarbon may have been due in no small measure to the lack of satisfactory cheap methods of manufacture. One method developed within recent years for large scale production[6] is based on the early observation by Tilden[7] that isoprene is one of the products formed in the pyrolysis of turpentine.

A logical raw material for the manufacture of isoprene is petroleum. Catalytic dehydrogenation, now in commercial operation[11] on butane feed stocks, is readily adaptable to isoprene production. The reactions involved may be represented by the equations.

$$i\text{-}C_5H_{12} \xrightarrow{-H_2} i\text{-}C_5H_{10} \xrightarrow{-H_2} i\text{-}C_5H_8$$

Isopentane — Isopentenes — Isoprene

Although two steps are indicated by this representation, in practice a single-stage process may be employed, for which the feed stock can be either isopentenes[5], isopentene-isopentane mixtures, or isopentane. The latter charging stock is available not only through the fractionation of straight run and natural gasolines but also from production of isopentane as a result of the recent development of catalytic isomerization[2].

Scope of Work

This paper is concerned with a laboratory-scale investigation of the production of isoprene by catalytic dehydrogenation and deals chiefly with a study of the effect of charging stock composition and operating conditions on isoprene yield. The process is considered on a recycle basis. Since for commercial operation one phase of the process will involve regeneration of the catalyst by combustion of the carbonaceous deposit, the effect of the process variables on carbon deposition has also been determined.

The series of tests discussed covers a range of feed stock compositions from pure isopentane to "pure isopentenes." The process variables involved and ranges of conditions systematically investigated are listed in Table 1.

Charging Stocks: The *isopentane* was obtained from Phillips Petroleum Co. and had a specified purity of over 99%. Mixed *isopentenes* boiling in the range 30-39° C. were obtained by dehydrating tert-amyl alcohol over activated alumina at 400° C. and fractionating the product. The bromine number[8] of this material was 228-229 (calculated for C_5H_{10}:228.6).

Catalyst: Regenerated U.O.P. commercial dehydrogenation catalyst, pre-aged by 21 days of service (this includes regeneration time) in pilot plant dehydrogenation of butane, was used in the form of ⅛-in. by ⅛-in. cylindrical pellets. A separate sample from a well-mixed stock supply of this material was employed in each run.

Apparatus and Procedure

Dehydrogenation Unit: A diagram of the apparatus used for the dehydrogenation is shown in Fig. 1-a. Charging stock was admitted to the reaction tube from a burette, the flow rate being controlled by means of a Hofer needle valve. The burette was provided with a glass jacket (not shown) through which ice water was circulated when the more volatile mixtures were used. The clear quartz reaction tube was heated by means of an aluminum bronze block electric furnace, the temperature of which was automatically controlled to within 1° C. Catalyst was placed in the approximately constant temperature zone of the tube (the volume of catalyst was sometimes varied within this zone as a method of controlling space velocity), and a layer of quartz chips above this zone was utilized as a preheating section.

The effluent was chilled in dry-ice traps to condense the liquid product. Gas was pumped from the system by means of either a glycerol-filled Nelson pump or Roliator through another dry-ice trap and was either metered or measured by collecting it in a gasholder over salt water. Pressure was controlled automatically by a solenoid valve arrangement[5]. When the operation was conducted at atmospheric pressure, the vacuum pump was merely by-passed.

In starting each run, the catalyst was pre-reduced for a short period (usually 5 to 10 minutes) with a stream of hydrogen before reducing the pressure. Likewise, at the termination of each run, the hydrocarbon vapors were flushed from the tube with hydrogen.

Analytical Procedures: "Noncondens*able gas*" was analyzed by conventional absorption and combustion methods[9]. The weighed, combined, recovered liquid condensates from each run were fractionated in a Podbielniak column to a vapor temperature of 10°-12° C. to remove any C_4 and lighter hydrocarbons. The residue was then subjected to a simple vacuum distillation at room temperature (about 25°C.) by reducing the pressure gradually to 5 mm. and collecting the distillate in dry-ice traps; the charge, distillate, and residue were accurately weighed.

The distillate from the vacuum distillation is hereafter referred to as the C_5 cut. This cut was not taken overhead during the Podbielniak distillation at atmospheric pressure since the holdup of C_5 in the fractionation equipment would represent a considerable percentage of the charge with the usual small sample involved. In the fractionation of a sample of the vacuum distillates composited from a number of runs made under varied conditions, over 98% distilled below 37° C.

Isoprene in the C_5 cut was determined by means of the Diels-Alder reaction with maleic anhydride. The procedure employed was as follows:

A 2- to 3-gram sample of the hydrocarbon is sealed in a small Pyrex tube with an excess (generally 3 to 4 grams) of maleic anhydride, both materials being accurately weighed on an analytical balance. The tube is mechanically agitated in a thermostat for 1 hour at 60° C. It is cooled, the tip opened, and volatile material carefully distilled into a dry-ice trap by keeping the tube at room temperature and gradually reducing the pressure to a final value of about 5 mm. The residue is accurately weighed on an analytical balance, the increase in weight over the original maleic anhydride being consid-

TABLE 1—Process Variables

Outlet pressure, millimeters of Hg., absolute	80 to 745
Liquid hourly space velocity* (*LHSV*) at 60° F.	1.5 to 12.0
Temperature (furnace block), ° C.	615 to 660
Process period length†	Constant at 30 minutes

*Volumes of liquid charged per hour per gross volume of catalyst zone.
†Length of time charging stock is passed through catalyst bed between successive regenerations.

Presented before the American Institute of Chemical Engineers, Cleveland, May 14-16, 1944, and published in the Aug. 25, 1944, Transactions of the Institute. *Both authors are with the Universal Oil Products Co., Chicago.*

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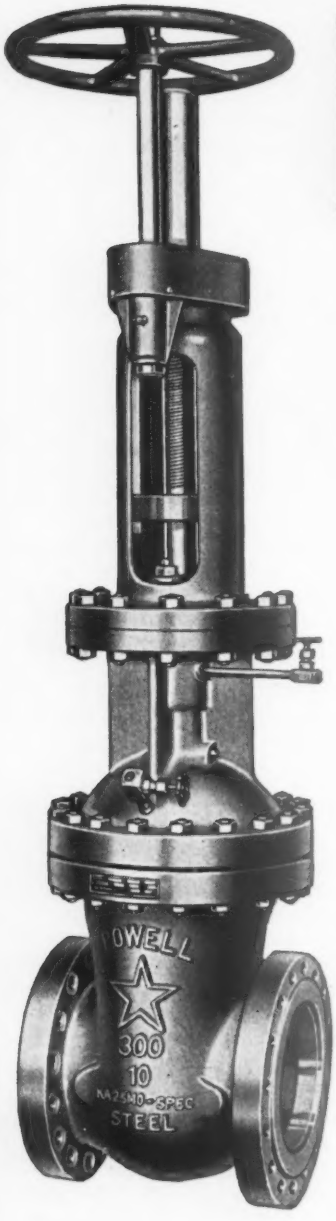

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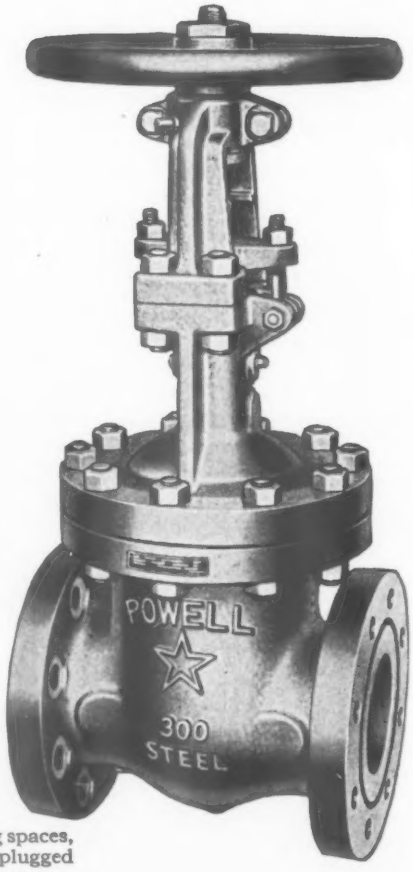

Fig. 3003—A 300-pound Cast Steel Gate Valve. Has ring joint flanges. Extra long stuffing box provides space for ample packing below and above lantern ring. This arrangement protects packing above lantern ring and eliminates leaks. Opposite sides of packing spaces, at the lantern ring, are drilled, tapped and plugged for either attaching a drain, if necessary, or providing for lubrication at this point.

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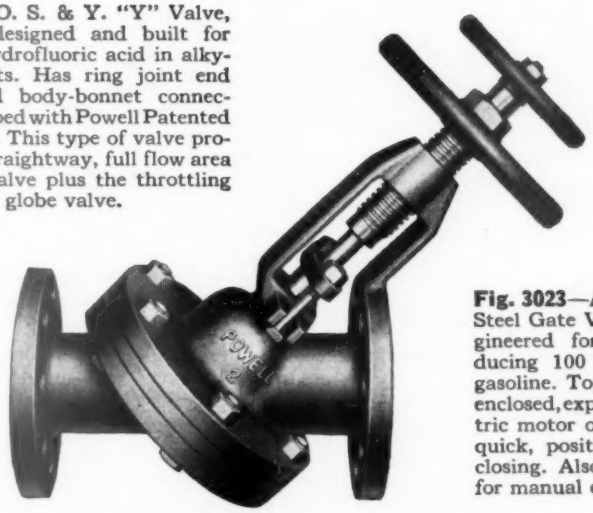

Fig. 1097SW—Special Alloy Separable Body Reversible Seat "Y" Valve, especially adapted for handling hydrochloric acid in isomerization units. Provides straightway flow area through the body. Equipped with Powell Patented Seat Wiper for clearing seat and disc faces of adhering material, assuring a leak-proof metal to metal contact.

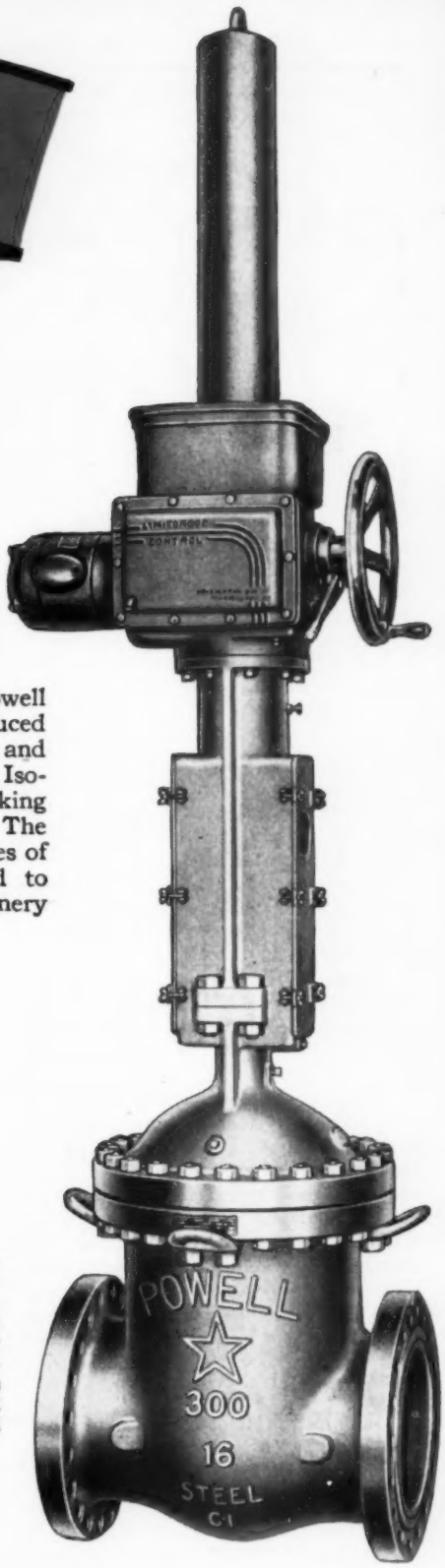

Fig. 3023—A 300-pound Cast Steel Gate Valve, Powell engineered for refineries producing 100 octane aviation gasoline. Top-mounted, fully enclosed, explosion-proof electric motor operator provides quick, positive opening and closing. Also has handwheel for manual operation.

VALVES

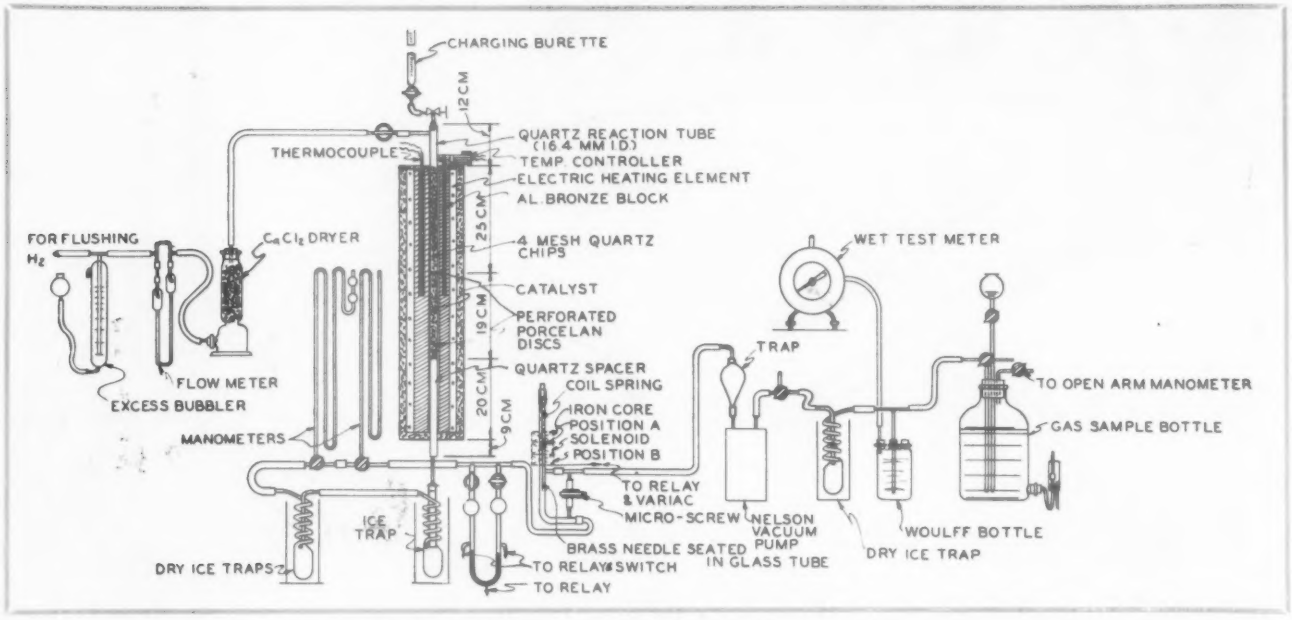

Fig. 1-a—Diagram of dehydrogenation apparatus

cred as isoprene. The use of more drastic conditions, viz., 1 hour at 100° C. with synthetic samples, resulted in absorption somewhat in excess of the percentage of isoprene in the sample.

The *mono-olefin* content of the C_5 cut was obtained by determining the bromine number[8] of the distillate from the maleic anhydride treatment.

Carbon on the used catalyst from each run was determined by grinding the entire quantity of catalyst used and running combustion analyses[10] on thoroughly mixed samples.

Methods of Calculating Results

A recycle system producing isoprene from isopentane, isopentene, or isopentane-isopentene mixtures can be represented by the scheme in Fig. 1-b.

The laboratory tests were all a once-through operation. However, the data obtained were used to calculate yields obtainable by recycle operation in accordance with the scheme in Fig. 1-b. Thus, the charging stock used in the laboratory tests corresponds to the combined feed of the recycle process. The composition of the effluent from the dehydrogenation step was determined analytically, and from these data the composition of the fresh feed can be calculated. Conversion, isoprene recycle yield, and fresh feed composition are defined by the relations given below, where

P_{cf} = weight of paraffins in the combined feed,

P_p = weight of paraffins in the C_5 cut of the product,

O_{cf} = weight of olefins in the combined feed,

O_p = weight of olefins in the C_5 cut of the product,

D = weight of diolefins in the C_5 cut of the product.

Conversion =

$$100\frac{(P_{cf}+O_{cf})-(P_p+O_p)}{(P_{cf}+O_{cf})}$$

This is the weight-per cent of combined feed converted per pass.

Isoprene Recycle Yield =

$$\frac{100D}{(P_{cf}+O_{cf})-(P_p+O_p)}$$

This is the ultimate isoprene yield expressed as weight-per cent based on the fresh feed.

Fresh Feed Composition.

Paraffin (per cent by weight) =

$$\frac{100(P_{cf}-P_p)}{(P_{cf}+O_{cf})-(P_p+O_p)}$$

Olefin (per cent by weight) =

$$\frac{100(O_{cf}-O_p)}{(P_{cf}+O_{cf})-(P_p+O_p)}$$

The factor 100 C/C_5H_8 is used in some of the correlations. This is the ratio of catalyst carbon to isoprene produced, both being expressed on a weight basis, and multiplied by a factor of 100 to avoid fractional values. This may be conveniently thought of as the pounds of carbon which it is necessary to burn from the catalyst during regeneration for every 100 pounds of isoprene produced during the process period.

It is apparent that these calculations are based on quantitative separation of isoprene and recycle stock. How nearly these calculated yields can be approached by actual recycle operation will depend upon the efficiency of the separation step, a factor outside the scope of this paper.

Further, no differentiation between iso- and normal C_5 hydrocarbons is made by the analytical methods described above, although special tests indicate that a limited amount of isomerization of the iso- to normal compounds does occur.

Yields have been adjusted to a recovery basis to eliminate unaccounted losses. Ordinarily such losses amounted to less than 5% of the charge and were usually positive, sometimes negative.

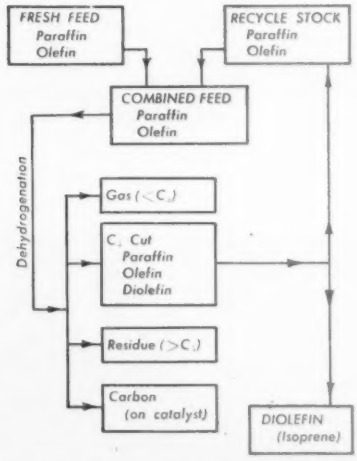

Fig. 1-b—Scheme for recycle system

Results

Detailed data on a few representative runs are given in Table 2. An extended series of such runs was made. The results were correlated by graphical methods in such a way that isoprene recycle yield, conversion, carbon formation, and other pertinent data for any fresh feed composition and any set of conditions within the investigated ranges could be accurately estimated. The curves of Figs. 2 through 6 are typical and show the trends involved.

Effect of Process Variables

Pressure: Considering isoprene production as a dehydrogenation-hydrogenation equilibrium, it is evident from theoretical considerations that a decrease in pressure will shift this equilibrium in favor of the dehydrogenation. The over-all

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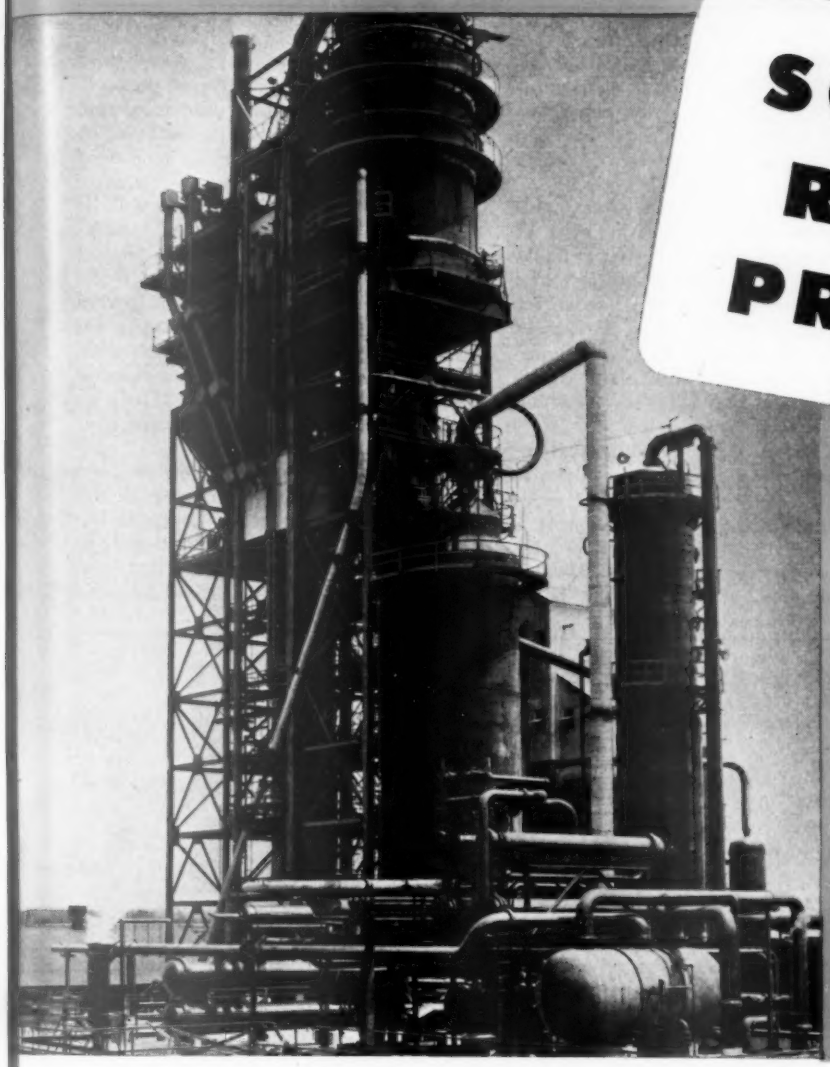

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effects shown in Figs. 2 and 3 are noteworthy. At a given space velocity, as pressure is decreased from 745 to 80 mm., the isoprene recycle yield increases markedly. The effect is even more pronounced when the conversion is kept constant by varying space velocity. In general, the isoprene concentration in the C_5 cut shows similar trends.

Although conversion is increased by an increase in pressure at a given space velocity, this is actually accomplished through augmentation of side reactions, and the net result is unfavorable. Particularly undesirable types of side reactions are those which result in the deposition of carbon on the catalyst. The effect of low pressure on minimizing carbon formation is clearly demonstrated by those curves featuring carbon-isoprene ratio.

Space Velocity: The chief effect of decreasing space velocity is to increase conversion. The higher conversions are accompanied by higher isoprene concentrations in the C_5 cut, and at the same time by lower isoprene recycle yields and higher carbon-isoprene ratios. (Figs. 2 and 3.)

Temperature: An increase in temperature increases conversion. The order of magnitude of the effect for one particular pressure and space velocity is illustrated in Fig. 4. For practical purposes an increase in temperature and a decrease in space velocity may be regarded as producing approximately equivalent effects within the range of conditions with which this paper is concerned.

Process Period: Under conditions where the rate of carbon deposition is low, it has been found by experiment that process period length can be varied over a multifold range with relatively minor effects on conversion and product distribution. Therefore, to simplify the treatment of the problem, the correlations which have been presented were purposely limited to a single process period length. A value of 30 minutes was chosen as reasonable for the range of conditions involved.

For actual plant operation, it will be desirable to avoid accumulating an excessive amount of carbon on the catalyst prior to regeneration, and it will be necessary to regulate the process period accordingly. For example, a shorter process period will be generally desirable for high-temperature high-space-velocity operation than for low-temperature low-space-velocity operation at the same conversion level.

Fresh Feed Composition: Fresh feed composition is expressed in terms of the per cent by weight of pentenes in the pentene-pentane mixture considered as fresh feed. It is to be expected that feed stocks of high olefin content will be more

TABLE 2—Catalytic Dehydrogenation of Isopentane-Isopentene Mixtures

Run Number (Arbitrary)	1	2	3	4	5	6	7
Combined feed composition, % by wt.							
Isopentane	60.0	0.0	85.0	75.0	60.0	0.0	85.0
Isopentenes	40.0	100.0	15.0	25.0	40.0	100.0	15.0
Catalyst volume, cc. (gross)	40.0	40.0	20.0	20.0	20.0	40.0	40.0
Process conditions							
Block temperature, ° C.	660	660	630	630	630	630	615
Pressure, mm. at tube exit	80	80	80	80	80	80	756
Liquid hourly space velocity at 60° F.	1.53	1.53	3.00	3.04	3.04	2.95	1.52
Process period length, minutes	30	30	30	30	30	30	30
Weight balance, grams							
Total hydrocarbon charged	19.55	19.30	18.93	19.31	19.48	39.00	19.10
Products							
Noncondensable gas	1.69	1.43	0.54	0.51	0.56	0.97	2.17
Liquid (includes C_3+C_4)	15.13	16.23	17.73	19.21	18.22	37.02	15.43
Carbon on catalyst	1.80	2.32	0.22	0.20	0.30	0.938	1.43
Loss	0.93	—0.68	0.44	—0.61	0.40	0.07	0.07
Noncondensable gas, liters at 0° C., 760 mm.	6.85	7.46	2.60	2.58	2.88	5.24	6.50
Used catalyst, grams	40.25	40.67	19.46	19.45	19.65	39.40	39.98
Yields, once-through, wt.-% on combined feed, adjusted to no loss basis							
Noncondensable gas	9.1	7.15	2.9	2.6	2.9	2.5	11.4
C_3+C_4	6.3	4.15	0.0	0.0	0.4	1.7	9.8
Isoprene	24.9	47.5	12.8	15.3	20.2	35.6	7.0
Pentenes	12.1	26.6	16.1	20.3	25.8	56.1	26.7
Pentanes	36.7	1.25	66.6	60.3	48.7	0.9	33.6
High-boiling residue	1.18	0.75	0.41	0.47	0.45	0.77	3.99
Carbon	9.65	11.6	1.20	1.00	1.58	2.41	7.50
Conversion, Wt.-% on combined feed	51.2	71.2	17.3	19.3	25.6	43.1	39.8
Isoprene recycle yield, Wt-% on fresh feed	48.8	66.6	74.1	79.2	79.1	82.8	17.6
Fresh feed composition, % by wt.							
Isopentane	45.6	—1.5	106.3	75.8	44.3	—1.9	129
Isopentenes	54.4	101.5	—6.3	24.2	55.7	101.9	—29
100 C/C_5H_8 (lbs. catalyst carbon per 100 lbs. isoprene)	38.8	24.4	9.4	6.6	7.8	6.8	107
Inspection of products							
Noncondensable gas, mol-% basis							
CO_2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total olefins	6.0	2.9	4.6	3.0	3.2	2.4	3.6
O_2	0.4	0.4	0.6	0.2	0.2	1.0	0.6
CO	0.8	0.5	0.8	1.4	1.6	1.2	1.0
H_2	81.2	83.6	85.4	87.2	87.2	84.7	70.0
Paraffins	9.4	9.8	6.6	6.4	6.4	5.3	21.8
Paraffin index	1.35	1.02	1.42	1.69	1.44	1.66	1.39
N_2	2.2	2.8	2.0	1.8	1.4	5.4	3.0
Mol wt. (N_2+O-free basis), calc.	5.51	4.28	4.66	4.46	4.34	4.14	7.46
Liquid (including C_{3+4}), wt.-% basis							
C_3+C_4 (to 12° C.)	7.8	5.2	0.0	0.0	0.4	1.8	12.2
C_5+	92.2	94.8	100.0	100.0	99.6	98.2	87.8
C_5+, wt.-% basis							
C_5 cut	98.4	99.0	99.6	99.5	99.5	99.2	94.4
High-boiling residue	1.60	0.97	0.42	0.49	0.47	0.83	5.61
C_5 cut, wt.-% basis							
Isoprene	33.9	62.1	13.4	15.9	21.4	38.5	10.4
Pentenes	16.4	36.2	16.8	21.1	27.2	60.6	39.7
Pentanes	49.7	1.7	69.8	63.0	51.4	0.9	49.9
Bromine No. of diolefin-free C_5 cut	56.9	219	44.3	57.4	79.1	225	102
Carbon, wt.-% on used catalyst	4.46	5.71	1.09	1.03	1.54	2.38	3.58

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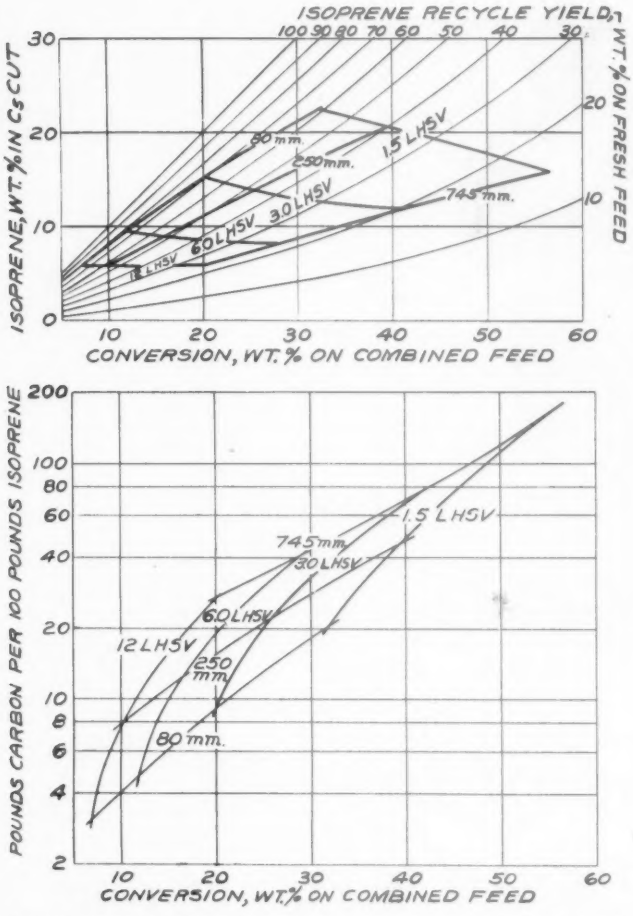
ISOPRENE RECYCLE YIELD, WT. % ON FRESH FEED
100 90 80 70 60 50 40 30
ISOPRENE, WT. % IN C5 CUT
CONVERSION, WT. % ON COMBINED FEED
80 mm.
250 mm.
745 mm.
1.5 LHSV
3.0 LHSV
6.0 LHSV
12 LHSV
POUNDS CARBON PER 100 POUNDS ISOPRENE
CONVERSION, WT. % ON COMBINED FEED

Fig. 2 (above)—Dehydrogenation of isopentane fresh feed. Effect of pressure and space velocity at 630° C. block temperature

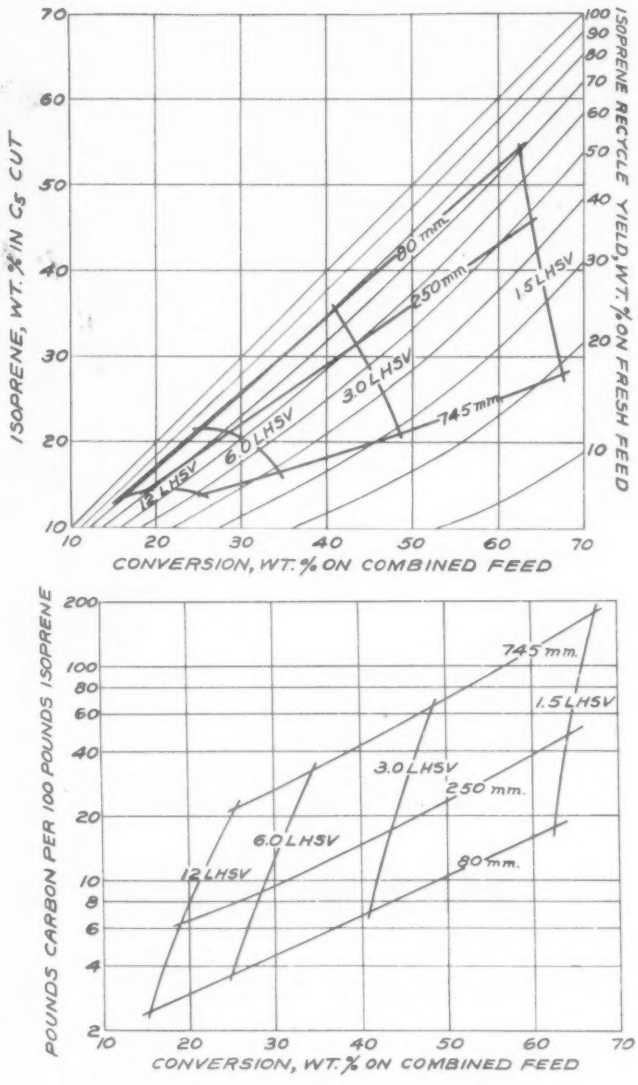

Fig. 3 (right)—Dehydrogenation of isopentene fresh feed. Effect of pressure and space velocity at 630° C. block temperature

favorable for isoprene production since they may be regarded as already partially dehydrogenated. Three different compositions (0, 50, and 100%) are considered in Figs. 4 and 5, and operation with the two extreme compositions, i.e., pure isopentane and "pure isopentenes," is illustrated in Figs. 2 and 3, respectively. An increase in the olefin content of the fresh feed increases conversion and isoprene concentration in the C_5 cut. In spite of the higher conversion, isoprene recycle yield also increases, and carbon-isoprene ratio either remains at about the same level or decreases slightly.

It is apparent that the theoretical isoprene recycle yield as expressed on a weight-per cent basis varies within narrow limits as a function of fresh feed composition. For feed stocks containing 0, 50, and 100% by weight of isopentenes, these limiting yields are, respectively, 94.4, 95.8, and 97.1% by weight.

Fresh feed composition is the variable which has a predominating effect in fixing the composition of the combined feed. The relationship between the two feeds shown in Fig. 6 is typical. The curve is shifted slightly by variation in pressure, space velocity, or temperature but the general trend remains the same.

Isomerization Accompanying Dehydrogenation

The extent of formation of compounds in the C_5 cut of the normal rather than iso-structure was determined in two cases. The method consisted in catalytically hydrogenating the C_5 cut, using U.O.P. commercial hydrogenation catalyst at 50° C. under a hydrogen pressure of 100 atmospheres and determining the *n*-pentane content of the product by infrared absorption spectrum. The charging stock (combined feed) was also analyzed by the same method.

The results, summarized in Table 3, show a net increase in the *n*-C_5 content of the C_5 cuts amounting to 4.6 and 5.0%. These normal compounds eventually will be converted to piperylene (1,3-pentadiene)[5] and it is likely that any chemical method employed for the separation of isoprene from recycle stock will allocate the piperylene to the isoprene concentrate. Whether the presence of the

TABLE 3—Isomerization Accompanying Dehydrogenation

Run number (arbitrary)	8	9
Combined feed composition		
Pentenes, wt. %	40	100
Pentanes, wt. %	60	0
Normal structure, % (±0.5)	0.9	1.5
Process condition		
LHSV at 60° F.	2.03	2.02
Exit pressure, mm.	80	80
Block temperature, °C.	630	630
Process period, minutes	30	30
Inspection of C_5 cut of product		
Normal structure, % (±0.5)	5.5	6.5
Wt. % isoprene	26.2	48.4

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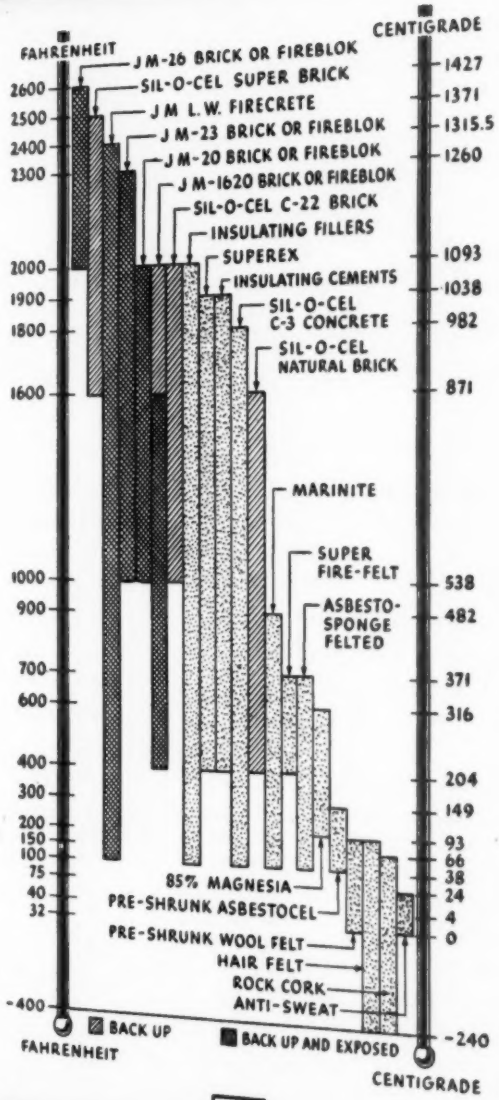

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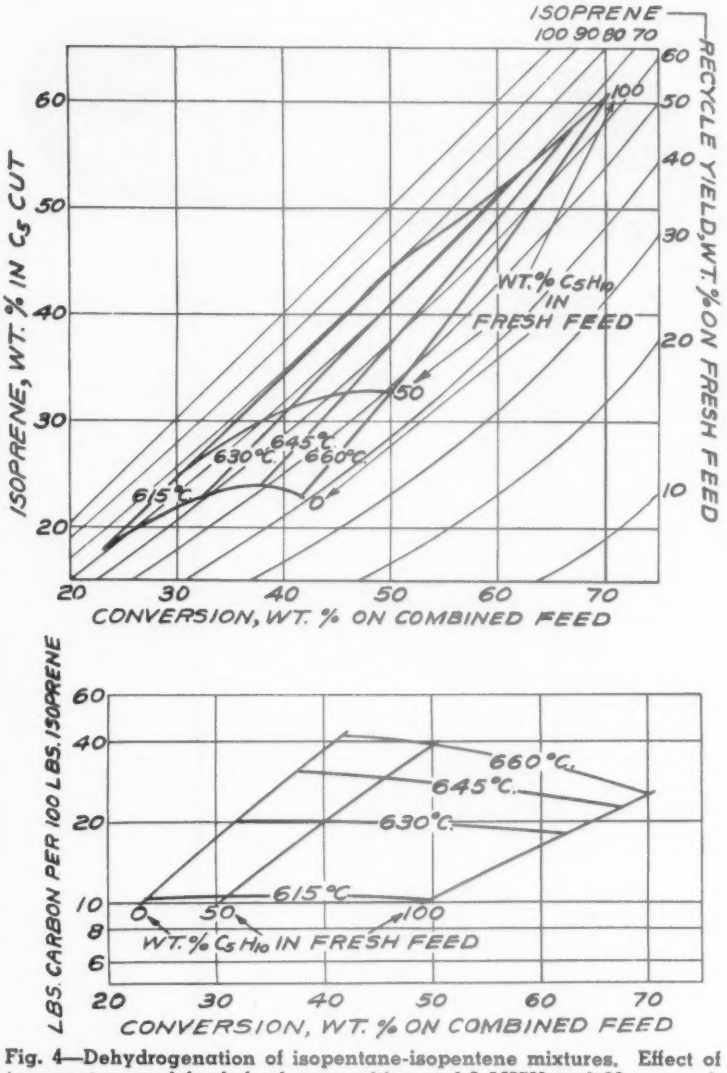
ISOPRENE
100 90 80 70
ISOPRENE, WT. % IN C_5 CUT
RECYCLE YIELD, WT. % ON FRESH FEED
WT. % C_5H_{10} IN FRESH FEED
615°C.
630°C.
645°C.
660°C.
CONVERSION, WT. % ON COMBINED FEED
LBS. CARBON PER 100 LBS. ISOPRENE
WT. % C_5H_{10} IN FRESH FEED
CONVERSION, WT. % ON COMBINED FEED

Fig. 4—Dehydrogenation of isopentane-isopentene mixtures. Effect of temperature and fresh feed composition at 1.5 LHSV and 80 mm. exit pressure

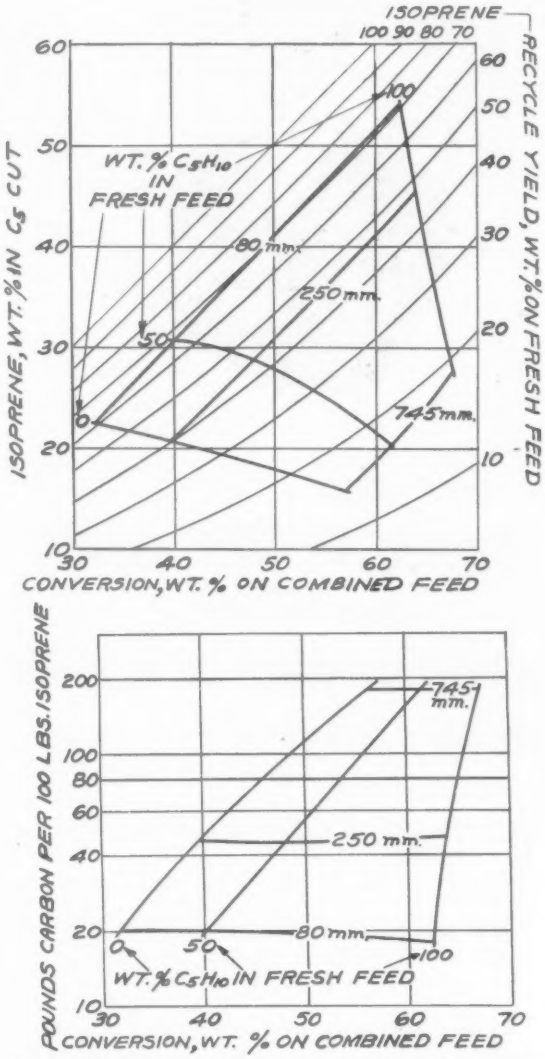
ISOPRENE
100 90 80 70
ISOPRENE, WT. % IN C_5 CUT
RECYCLE YIELD, WT. % ON FRESH FEED
WT. % C_5H_{10} IN FRESH FEED
80 mm.
250 mm.
745 mm.
CONVERSION, WT. % ON COMBINED FEED
POUNDS CARBON PER 100 LBS. ISOPRENE
745 mm.
250 mm.
80 mm.
WT. % C_5H_{10} IN FRESH FEED
CONVERSION, WT. % ON COMBINED FEED

Fig. 5—Dehydrogenation of isopentane-isopentene mixtures. Effect of pressure and fresh feed composition at 1.5 LHSV and 630° C. temperature

chemically similar piperylene in the isoprene concentrate will be undesirable and require further separation, e.g., by fractional distillation, will depend upon the use intended for the isoprene.

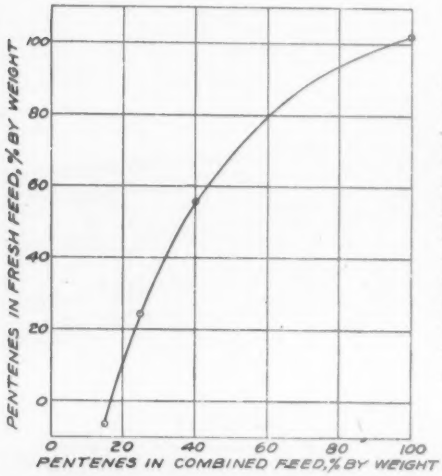

Fig. 6—Relation between fresh feed and combined feed composition at 80 mm. exit pressure, 3.0 LHSV and 630° C. block temperature

Properties of Separated Isoprene

A composite C_5 cut from a series of runs which was made under varied conditions analyzed 15.2 wt.-% isoprene. When treated with cuprous chloride the isoprene-cuprous chloride addition compound[4] was formed; 64% of the isoprene present was converted. The isoprene quantitatively recovered from the addition compound by heating under reduced pressure distilled completely in the range 33.8°-35.0° C. at 750 mm. and the distillate had n_D^{20} 1.4222. Literature values for isoprene are b_{760} 34.076 and n_D^{20} 1.42158[3].

Acknowledgment

The authors express their appreciation to Roland B. Day, who suggested this investigation. They also acknowledge their indebtedness to Louis S. Kassel for certain methods used in planning the tests and correlating the data; to W. S. Galloway for the infra-red analyses; and to the analytical staff of Universal Oil Products Co. for the carbon and gas analyses.

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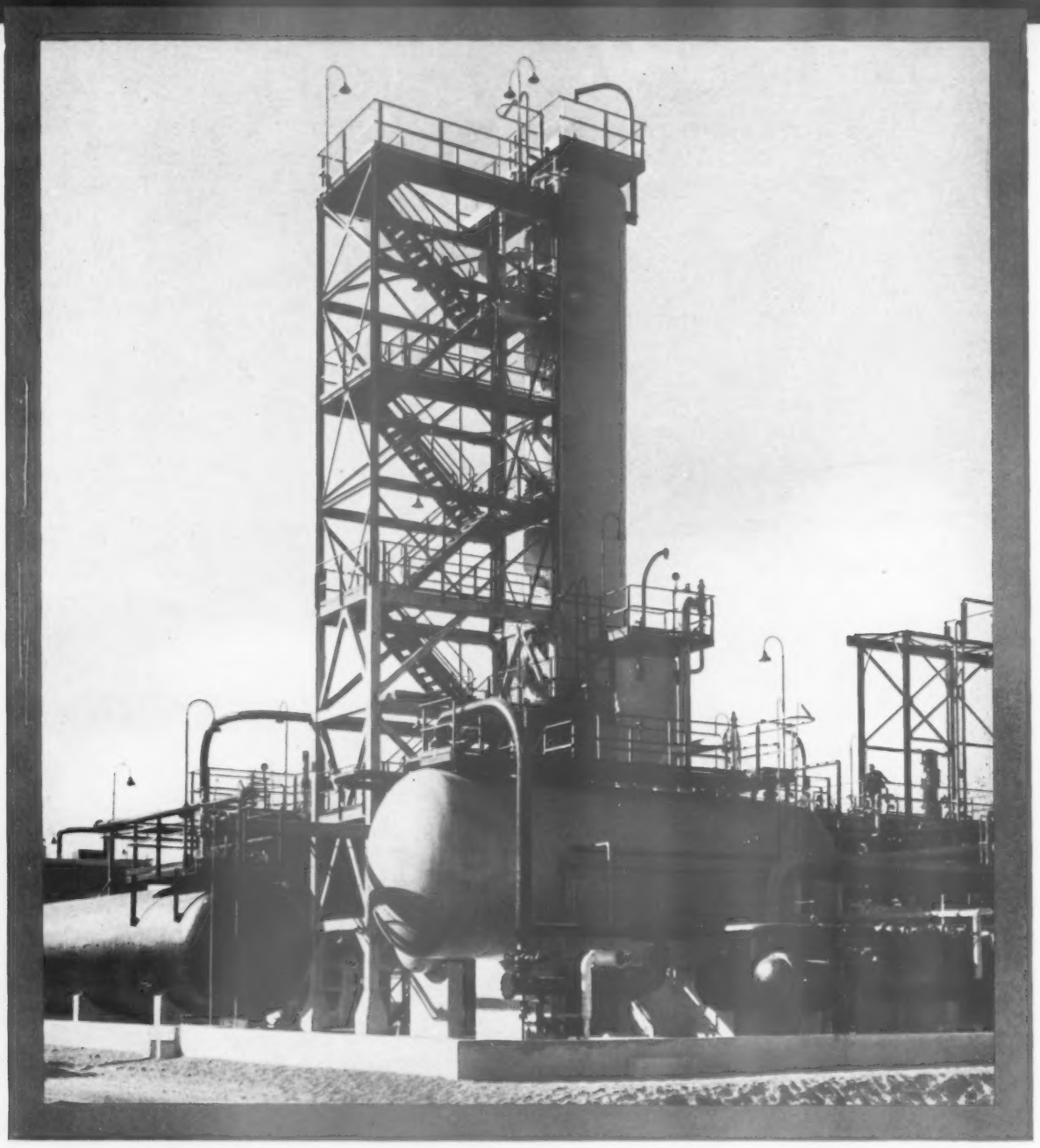

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Cooling Water and Effluent Treatment In Butadiene Manufacturing

By Paul J. Stein

Over 1200 pounds of cooling water are required for the condensation or cooling of the distilled vapors in producing one pound of butadiene, at a plant with rated capacity of 80,000 tons annually of butadiene from alcohol. The successful functioning of the plant is dependent upon the supply of the large volume of service water required, without disturbances which might throw the chemical processes out of line. Special treatment is required for a small portion of contaminated effluent from the butadiene and styrene units. Treatment of the boiler feed water in the same plant is briefly described.

IN THE production of one pound of butadiene from alcohol, approximately 20 pounds of steam are required for distillation purposes. Following the distillation step, in which the heat energy from the boiler house is utilized, the distilled vapors are condensed or cooled before proceeding to the next chemical operation. As over 1000 tons of coal per day are required to supply the heat to the chemical reactions, an enormous amount of energy must be removed to effect the desired condensation or cooling.

Undoubtedly, the chief reason for locating this plant at the site selected was the availability of a dependable body of water, the Ohio River. The problem of obtaining an adequate cooling medium was one of providing the proper facilities for conveying water from the river to the condensers in such a manner that no serious operating difficulties would be encountered.

To produce one pound of butadiene, it is necessary to pump 1200 pounds of water from the river and to treat chemically 35 pounds of water for boiler use. With such a relationship between plant product and water, the careful attention given to the water supply facilities was completely justified. In Table I, the quantity of river water consumed and its uses are indicated.

Pumping Station Location

About 96% of the water consumption is for cooling purposes, in which the basic requirements are not as severe as they are for water that is to be used for boiler feed purposes. For cooling, the water should not only be as cold as possible but it should be steady in pressure, free of all large foreign matter, noncorrosive and free of any algae growths. By providing the proper facilities, all of these requirements can be satisfied adequately (with the exception of the water temperature, over which we have no control.)

For boiler feed use, the requirements are much more severe than these basic ones, for it is of importance to have a source of water that is low in dissolved solids, suspended solids and scale-forming materials. Although the filtration plant consumes only 3% of the raw water taken from the river, it must be supplied with the highest quality water economically available.

From the cost standpoint, it would have been logical to build the river pumping station downstream of Raccoon Creek, as closely as possible to the major consumer, the butadiene units. Fortunately, however, the full importance of maintaining the proper boiler water conditions in the high pressure boilers that were to be installed at the plant was recognized long before any design or construction work was started. The site upstream from Raccoon Creek was selected for it was felt that the source of raw water should not be dependent on the quality of this creek.

As the successful functioning of the chemical plant is dependent on a continuous supply of all utilities, it was of paramount importance that the facilities installed for supplying water to the plant be as dependable as possible. Too much stress cannot be placed on the necessity of providing the basic utilities, steam, power and water, to the chemical plant without any interruptions whatsoever. A disturbance in any of these lasting only a matter of minutes can very easily cause the chemical processes to be thrown "out of line" so badly that several hours would be required to restore the various settings to normal again. Painstaking efforts have been expended in the original design and in the later improvements so that continuity of service would be easily obtained under all operating conditions.

The 6 deLaval centrifugal pumps may be considered as the heart of the station. The double-suction, single-stage pumps are driven at a speed of 900 RPM. by 1750 hp. synchronous electric motors having direct connected exciters. Each pump, being rated at 20,000 G.P.M. at a head of 278 ft., has a daily capacity of over 28,000,000 gals. With 6 pumps in service, maximum output from the station is 114,000 G.P.M. On a daily basis, this is equal to 164,000,000 gals., which is enough water to satisfy the demands of a city two to three times as large as Pittsburgh.

Two separate 13,800-volt feeders are used in supplying current to the station from the main bus in the power plant. Over 55% of the electrical energy consumed by the entire chemical plant is used in pumping the water from the river to the plant. A rather elaborate arrangement of electrical relays and automatic devices is installed for the protection of the equipment.

Two motor-driven vacuum pumps, a steam ejector, and a hydraulically-operated ejector are available for rapid priming of any pump. The vacuum system operates automatically through the use of pressure switches, solenoid valves and electrode chambers. To aid in maintaining a steady pressure in the distribution system without any dangerous surges, each pump is equipped with an S. Morgan Smith roto-cone valve, oil-operated.

The operation of these valves is set so that a pump can be placed in service or removed from service with only the slightest fluctuation in the header pressure. The discharge check valve opens automatically when the pump is at full speed and closes automatically whenever the pump unit is shut down or a power failure occurs. Power to operate the roto-cone valves is supplied from a separate oil pressure accumulator. The tank and piping are sized to provide dependable hydraulic power sufficient to close the 6 discharge valves before reversal of rotation of any pumping unit can take place.

For further protection against any surges in the distribution system that might cause disastrous results to the piping, 5 surge relief valves are installed on the main discharge header in the pumping station. The surge relief valves, manufactured by S. Morgan Smith, are set to operate on both low and high pressure in the water system, as well as upon a power failure.

We have noted that one of the basic requirements of good cooling water is that the water be free of all large foreign matter. To fulfill this necessity in

The accompanying article is a principal portion of the paper "Water Treatment at Koppers United Co. Plant, Kobuta, Pa.", presented before the Fifth Annual Water Conference, Engineer's Society of Western Pennsylvania, Pittsburgh, Oct. 31, 1944. Paul J. Stein, the author, now of Koppers United Co., was formerly associated with Hall Laboratories, who supervised the water control and treatment at the Kobuta plant.

an acceptable manner, the removal of the objectionable materials is accomplished by three distinct methods. Large floating debris is prevented from entering the station by trash bars. These are accessible for cleaning by means of a walkway. Four traveling screens are available for the elimination of any particles that might pass the trash bars. A Brassert strainer, with a wire mesh of 20-to-the-inch, is provided with each pump for the final step in the removal of any foreign matter that might cause fouling of the heat exchangers through which the water passes.

Service Water Distribution

Owing to the stringent priority ruling existing at the time that the plant was constructed, the fire and service water systems were combined into one system. With this possible objection, it can, nevertheless, be stated that the distribution system, as a whole, has been well planned. The butadiene and styrene units obtain their supply from the large loop while the boiler plant and the filtration plant are located on the smaller loop. A special valve arrangement, installed after the plant was placed in operation, permits the boiler plant and the filtration plant to receive water even though a part of the loop is damaged and out of service.

The water, in leaving the river pumping station, flows through two 54-inch pipe lines for a distance of approximately ¾ of a mile to reach the plant. Both lines are amply protected by a special concrete encasement at the Raccoon Creek crossing. One line is made of cast iron, while the other one has reinforced concrete construction. In the distribution system, the small loop around the filtration plant consists of transite pipe. Likewise, the 36 in. line connecting the plant distribution system to the reservoir is of transite construction.

The reservoir, having a capacity of 3,000,000 gals., is equipped with a double-acting altitude valve. Also, the river pumping station has a telemeter, recording the reservoir level. This arrangement makes it possible to secure good pumping efficiency by means of the "rise and fall" in the reservoir. In this manner the full output of each pump is obtained at all times, thereby resulting in a low power consumption per gallon of water delivered.

Design For Flood Protection

With the chemical plant located so that it is high above any flood dangers, the designers, Morris Knowles, developed plans for the building and arrangement of the equipment so that it is possible to withstand a flood 6 ft. higher than the crest reached in 1936. This would mean that water could rise 32 feet above the normal pool before pumping operations would have to be curtailed. To provide for this protection a special design of the structure had to be made, in which the base of the walls is 4 ft. in thickness. The protection extends to 4 ft. above the operating floor level by means of barricades.

Should a flood of such magnitude be reached, the bottom of the main circuit breakers and transformers would be under water while operations continued. Access to the station is by means of an elevated roadway that is approximately at the level of the operating floor.

TABLE 1—Service Water Distribution at Kobuta

Consumer	Quantity %	Use
Butadiene	72	Cooling
Styrene	24	Cooling
Filtration Plant	3	Treatment
Boiler Plant	1	Ash Removal
Fire Hydrant & Sprinklers	..	Fire Protection
		G.P.M.
Total Service Water Pumped (Summer Months)		110,000
Total Pumping Capacity Available		114,000

Treatment of River Water

Two of the fundamental requirements of acceptable cooling water are that it be non-corrosive, and that it be free from objectionable algae growths. With a major portion of the plant being equipped with heat exchangers having non-ferrous tubes, the objection to the corrosiveness of the river water is confined to that part of the plant having steel tube condensers. As a few tubes have failed through corrosion in such a unit, it was decided to install equipment for the application of the "Threshold Treatment" in one particular area. This apparatus, now being placed into service, is being installed with the thought in mind that, should the corrosive tendency of the water be greatly reduced in effectiveness, the treatment will be extended to protect other steel tube condensers.

While the application of the "Threshold Treatment" is being done on a "local" basis, the control of algae growths is on a plant wide scale. A Wallace-Tiernan vacuum chlorinator for de-sliming is installed at the river pumping station for the feeding of chlorine into the water. Under present conditions, the chlorinator operates three times daily with the length of each chlorinating period being 90 minutes.

A careful check of residual chlorine leaving the various condensers in the plant is made so that an adequate amount of chlorine may be fed into the service water to destroy all algae and slime growths. Liquid chlorine for this use is received at the plant in ton containers. Storage space for 22 containers is provided in a separate building located adjacent to the station.

In preparing the river water for boiler feed purposes, some fairly elaborate facilities are required. A later section of the paper discusses briefly the softening and filtering equipment.

First Year's Experience

Having presented an outline of the various features of the design, the construction and the operating facilities of the water supply system, it is of interest to review briefly the operating experiences encountered in the first year of operation. From the period when one pump satisfied all demands in the early days of operations to the full capacity conditions encountered during the summer months last year, the aim of "continuity of service" has been held uppermost in the minds of the operating personnel. During this period several "weak spots" were uncovered which, if permitted to exist, would always be a source of trouble. Particular emphasis has been placed on the elimination of any condition or arrangement that had the slightest possibility of disturbing the steady operation of the water supply system.

During the design and construction periods, it was planned to produce 80,000 tons of butadiene per year. The water pumping facilities were conservatively designed to adequately supply cooling water for this output. With the intensification of the aerial warfare came the demand for more and more aviation gasoline. This meant that, if the air fleets of the United Nations were to receive the fuel needed, the butadiene that was to be produced by the petroleum industry would, by necessity, have to be curtailed. The demand for synthetic rubber, nevertheless, continued to exist and actually became greater. Faced with such a situation, it was imperative that the plants that convert alcohol into butadiene should produce every pound that they possibly could.

As a result, the output of butadiene at Kobuta is more than 50% greater than originally contemplated. Such a large increase in production meant that the river pumping station, instead of having ample capacity, was forced to operate at practically full rating during the summer months. During the month of August the "operating pump hours" was 98% of the "available pump hours."

With such a high demand factor at the present time, it would probably not be possible to provide enough water next summer when the chemical and boiler facilities now being installed will be in operation. With the special flood protection design, it is not an easy matter to remove the end wall and add another pump. Fortunately, the motors driving the pumps are not overloaded, so it will be possible to install larger rotors to increase the output by approximately 10%. It is intended that this improvement in pumping capacity will be available before next summer.

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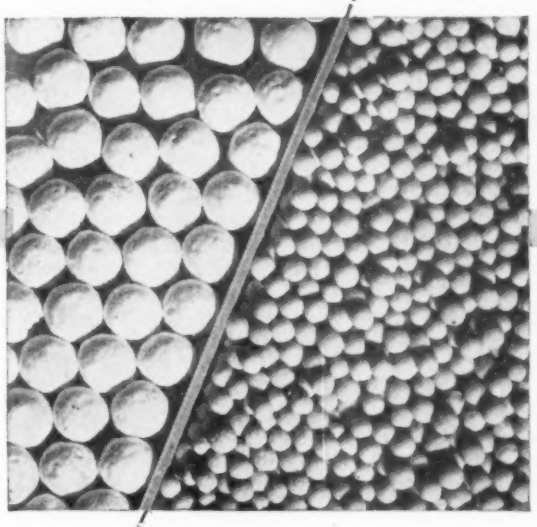

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possible from the station in the meantime, a special arrangement has been developed in which the reservoir may be isolated from the plant. By maintaining a lower plant header pressure, and, hence, a lower pumping head, the station output can be increased. This is only a temporary expedient that may be used should an emergency arise in which the demand exceeds the pumping capacity available.

As the entire plant is, minute by minute, dependent upon the steady supply of water, it is highly important that extra precautions be taken to assure an uninterrupted flow of water. Practically every auxiliary in the station has been improved or altered so that the supply system would not be subject to minor difficulties. The oil accumulator system for the operation of the discharge check valves has been strengthened through the adding of additional compressing, pumping and storage facilities. It should now be able to cope with any condition that may be encountered. To assure rapid pump priming a steam jet ejector has been installed, supplementing the two motor-driven vacuum pumps and the hydraulic ejector. An auxiliary wash water drain is available for the traveling screens in case the main drain line becomes plugged.

In addition to these improvements in the mechanical auxiliaries, many alterations have been made in the electrical facilities. Certain undesirable electrical arrangements have been eliminated while other desirable arrangements have been added.

The net result of the first year's pumping experience is that the personnel and equipment in the river pumping station are satisfying all of the demands made upon them for a steady supply of water.

While the basic treatment of screening, straining and chlorinating was sufficient for the large portion of water obtained from the river, it was necessary to provide for conditioning 4200 GPM for boiler use. Facilities for external treatment are located in the filtration plant, while the equipment required for internal treatment is situated in the boiler plant.

Briefly, the power plant consists of four 350,000 lbs./hour boilers designed for superheater outlet conditions of 725 lbs. pressure and 750° F. temperature. Three of the boilers are Babcock & Wilcox radiant type natural circulation units, and the fourth is a Combustion Engineering controlled forced-circulation boiler. Since the original construction was completed about a year ago, a fifth boiler, having a capacity of 180,000 lbs. per hour (450° F.) is being added. Total steam generating capacity available will be 1,580,000 lbs. per hour.

Over 97% of the steam consumed by the butadiene and styrene units is low pressure steam (165 lbs and 75 lbs). About 3% of the steam is delivered at 650 lbs. pressure. By installing high pressure boilers for steam generation and passing the steam through a steam turbine exhausting at 165 lbs. pressure, electrical energy is generated by the 35,000 kilowatt machine. With the plant electrical facilities consuming about 13,000 kilowatts, the excess electrical energy is sold to a utility company.

The three radiant-type Babcock & Wilcox boilers, being more or less of the orthodox design and being in successful operation in many plants under a variety of conditions, suggested no unusual problems insofar as the water conditioning requirements were concerned. In the case of the Combustion Engineering controlled forced-circulation unit, the water problem was indeed one of considerable importance. Being built at a time when the demand for steel was at its peak, the government specified that a forced-circulation boiler should be used. It was estimated that, by installing such a unit instead of the conventional natural-circulation unit, approximately 40 tons of steel could be saved.

To provide satisfactory water for this unit was quite a problem for there were no other boilers of this design on which to obtain any operating data. The only other unit similar in design was installed at a large central station in the east where make-up water, which was evaporated, amounted to only a percent or so. With a make-up water requirement equal to 65% of the feedwater, and without any previous experience on such a unit having high make-up water, it was appreciated that the conditioning problem was one that would require close attention.

In the feedwater cycle, the water, after being heated and deaerated in Cochrane deaerators, passes through high-pressure heaters, which have steel tubes. The forced-circulation unit is equipped with an economizer. So that the efficiency of these heat exchangers would not be adversely affected, it was of considerable importance to provide water having a low residual hardness.

With the water conditioning system selected, the next step was to translate the engineering design specifications into a physical arrangement to produce the desired results. Major filtration plant equipment included:

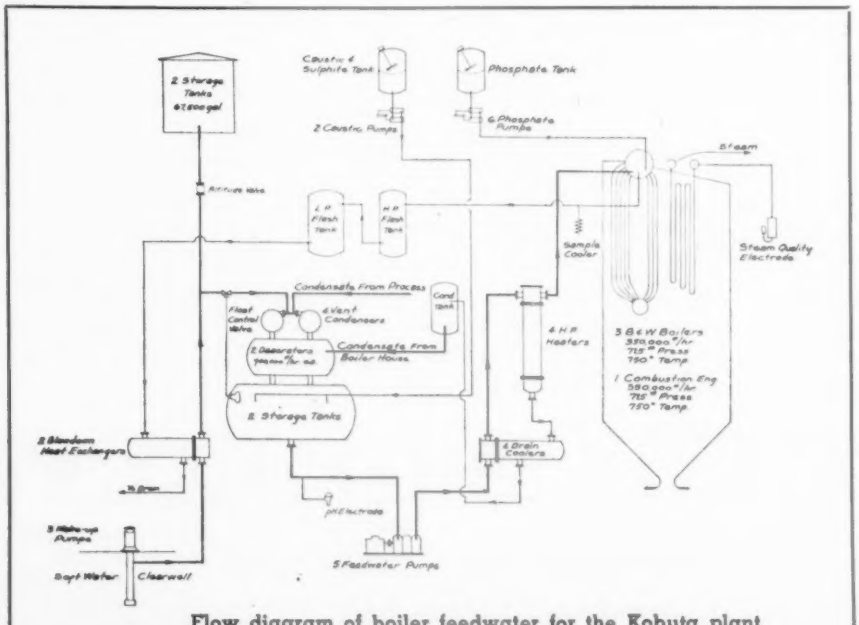
3—14 O. G. P. M. Spaulding precipitators; total capacity, 4200 G.P.M.

6—Gravity flow anthrafilt filters; total capacity, 3900 G.P.M.

6—Gravity flow carbonaceous zeolite softeners; total capacity, 3600 G.P.M.

1—Acid mixing chamber for pH control.

As far as boiler water treatment is concerned, sodium metaphosphate is fed directly into the upper boiler drum to satisfy the demands of the residual hardness of the boiler feedwater by means of small reciprocating proportioner pumps. All boilers are equipped with continuous blowdown lines discharging into a 165-lb. flash tank.



Flow diagram of boiler feedwater for the Kobuta plant

Effluent Treating Facilities

Not only is it necessary to provide facilities for the pumping, distributing and treating of the water that is so vital to the successful operation of the various chemical processes, but it is likewise essential that adequate arrangements be made to handle the water after it has performed its function. This phase of the operations of the chemical plant is grouped under the general term Effluent Treatment. The problem can be divided into the following three distinct

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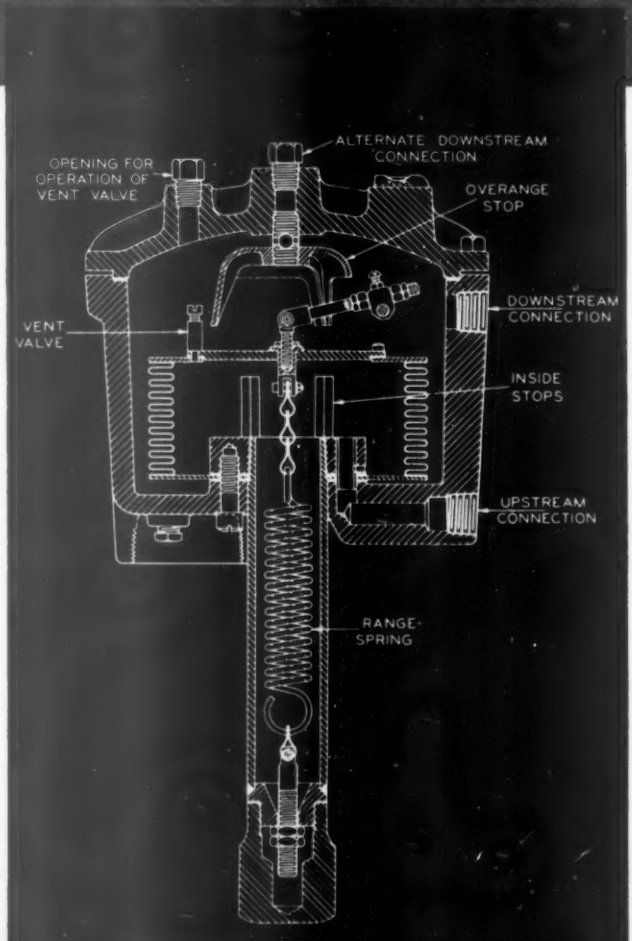

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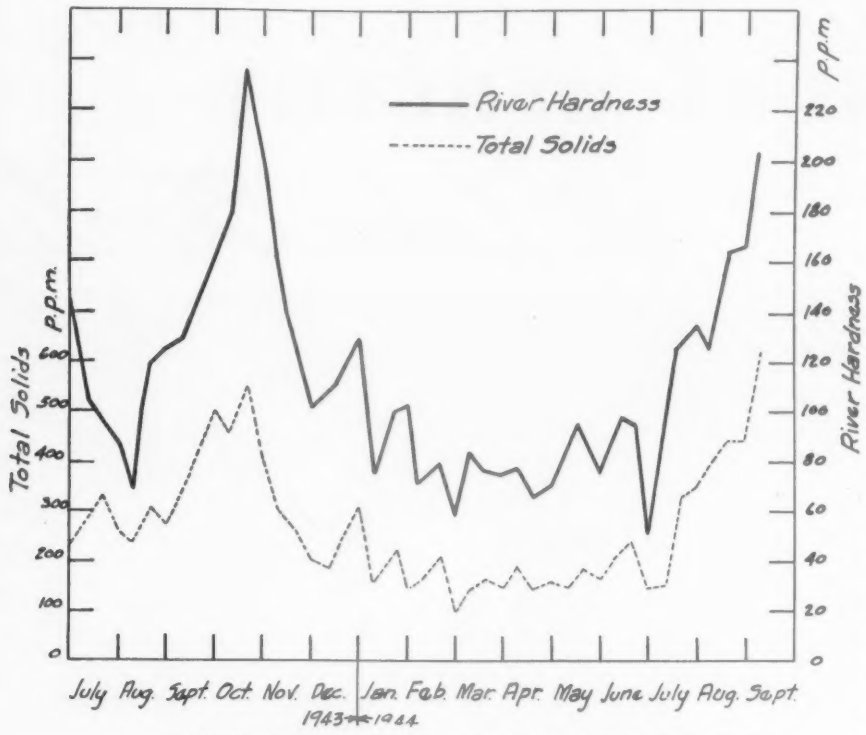

Hardness and solids characteristics of Ohio River water

classifications, uncontaminated water, contaminated water, and contaminated sewage.

The uncontaminated water, amounting to over 6,000,000 gals. per hour or roughly 99% of the plant effluent, comprises the principal stream. After the cooling water pumped from the river passes through the condensers and coolers it is discharged into a system of sewers that flow into one main sewer 84 in. in diameter. As a flow of 6,000,000 gals. per hour with a drop of over 50 feet to the river would erode the river bank in a short period of time, a specially-designed outfall was constructed to handle this effluent, as well as the discharge of the surface drainage. Through the use of this conduit, the energy of the falling water is dissipated without any injurious results to the river bank or to the river bed.

No treatment of any kind is needed, for the water, not being in direct contact with any chemicals, is uncontaminated. To be certain, however, that no nuisance to the waters of the Ohio river is being created, close control of this stream is practiced daily. Frequent samples are taken from the main and various individual sewers for determinations of oil content, odor, taste and B. O. D. Through the running of such tests it is possible to detect indications of leaky apparatus or excessive spillage. These are immediately corrected so as to maintain the production efficiency and prevent contamination of the water.

Contaminated effluent of about 80,000 gals. per hour or roughly 1% of the total plant effluent is the result of operations both in the butadiene and styrene plants. In various distilling operations, an aqueous residue containing traces of organic materials and some free oily material is discharged. The problem of properly treating effluent has been approached with the following ideas: (1) Removal of the insoluble oils; (2) neutralization of the acidity; and (3) reduction of odor and taste, and improvement of the biochemical oxygen demand.

For practically complete removal of insoluble oils a separating sump with 2½ hours detention time is in operation. For neutralization of the acidity, lime is mixed with the effluent so as to obtain a pH value of 9 or 10. This degree of alkalinity is controlled automatically by a pH controller that adjusts the rate of lime feed into the neutralization tank to counteract the acidity of the effluent.

Considerable attention is being put forth to devise a system which will give the maximum removal of odor and taste and improvement in the biochemical oxygen demand. The most practical solution at present appears to be the use of steam distillation in a fractionation column, and a pilot plant is being installed to test this solution on a small scale.

Rather than permit the waste materials from the plant's sanitary facilities to flow untreated into the river, a sewage treatment plant is in operation. A separate sanitary sewer system collects all of the domestic sewage from the service buildings and from the neighboring Kobuta homes for disposal. The sewage treatment facilities consisting of a screen chamber, two Imhoff tanks, and a four-compartment sludge bed, provide for primary treatment of sewage.

The existing equipment is designed to serve an ultimate population of 2000 persons at an average rate of water consumption of 50 gals. per capita per day. Detention period in the Imhoff tanks at this rate is three hours. Not only are the present day requirements being met, but plans are ready to adequately handle the sewage disposal problem that may be faced in the future.

Authority on Catalysis Added to Mellon Staff

DR. PAUL HUGH EMMETT, one of the foremost chemists of the country on research on catalysis, has been added to the investigational staff of Mellon Institute, Pittsburgh. He will plan and supervise long-range projects on catalysis of importance in petroleum technology, having the grade of senior fellow.

Dr. Emmett received his B.S. in chemical engineering at Oregon State College in 1922, and his Ph.D. degree at California Institute of Technology in 1925. In 1939 Oregon State College conferred on him an honorary Sc.D. He was engaged in studies on catalysis at the Fixed Nitrogen Laboratory of the U. S. Department of Agriculture, Washington, D. C., from 1926 to 1937 and during that period served as lecturer on catalysis at George Washington University. From 1937 until his recent appointment at Mellon Institute he was professor of chemical and gas engineering at Johns Hopkins University and also consultant of the U. S. Department of Agriculture. He has recently been engaged on essential wartime research for the government.

Dr. Emmett has made many notable contributions to the literature of adsorption and nitrogen fixation as well as catalysis.

Dr. Paul Hugh Emmett

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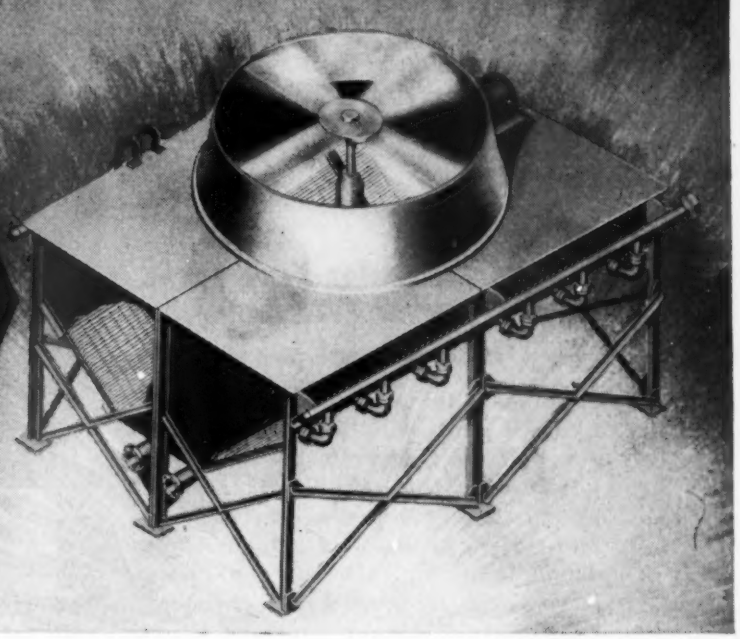

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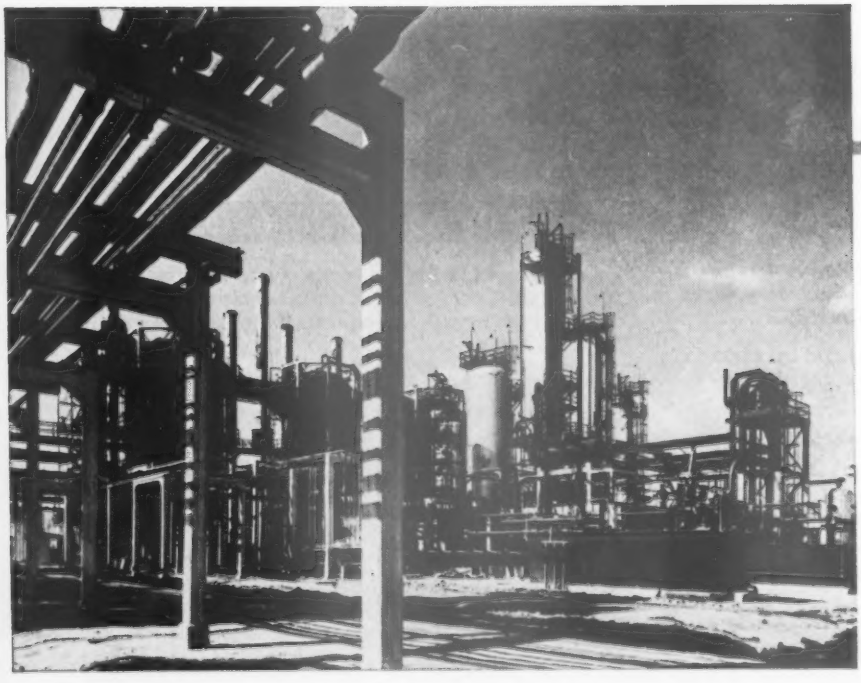

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Pilot Unit Segregates Hydrocarbons by Groups For Calculating Data Used in Tower Design

The securing of design data for precise distillation towers has been simplified by segregating hydrocarbon feed stocks into groups, each group being treated as a single hydrocarbon. The special type of pilot-plant column in which the hydrocarbon groups are segregated is described. An earlier article (Mar. 7, 1945, p. R-169) discusses some of the general problems in connection with the design of fractionating towers for the modern petroleum refining processes.

FRACTIONATION is, without doubt, the basic physical process of petroleum refining. This is particularly true in the new processes of isomerization and alkylation, where the extent of the chemical reaction depends to a great extent on the purity of the charging stock.

If the charge from a fractionating operation which precedes a chemical process, does not meet specifications for most economic treatment, the product yields are low and the chemical consumption high. This is not necessarily the fault of the equipment, for fractionation is a complex procedure involving many variables. It might well be that because of insufficient pilot plant data the process engineer could not readily determine the most effective operating conditions for the product.

Pilot plant data serves to clarify many operating problems—this is particularly important today when many large industrial units, often embodying unfamiliar processes, are being put into service with all possible speed. The experience and knowledge gained from pilot performance assures more efficient processing from initial start-up.

The accompanying article was originally published in the October-November-December, 1943, issue of Heat Engineering, of Foster Wheeler Corp., refinery engineers, New York, under the title "Stedman Pilot Unit".

To meet this very real need for the data necessary in designing industrial processes employing fractionation, Foster Wheeler has installed in its laboratory at Carteret works a Stedman-packed, pilot plant fractionating unit. It is shown in Fig. 1 and has the following characteristics:

1. A 6-in. diameter fractionating column housing 16 ft. of Stedman packing, having a separation capacity equivalent to approximately 100 theoretical plates.
2. A batch charging capacity of 160 gallons, making larger distillate fractions possible for complete analysis.
3. Automatic control of heat input to the still to maintain a constant pressure differential across the column, which permits achievement of maximum throughput rate.
4. Automatic top-of-column temperature control.
5. Wide range of operating pressure (from high vacuum to 300 psi.)
6. Electrically heated column jacket, permitting adiabatic column operation.
7. Heating of the still by electricity, steam, or Dowtherm vapor—use of the two latter in conjunction permitting accurate temperature control of the heating medium.
8. Semi or full continuous operation.
9. An overall height from floor line of less than 28 ft.

The basic feature of Stedman packing is that the flows of the liquid and of the vapor are along entirely independent

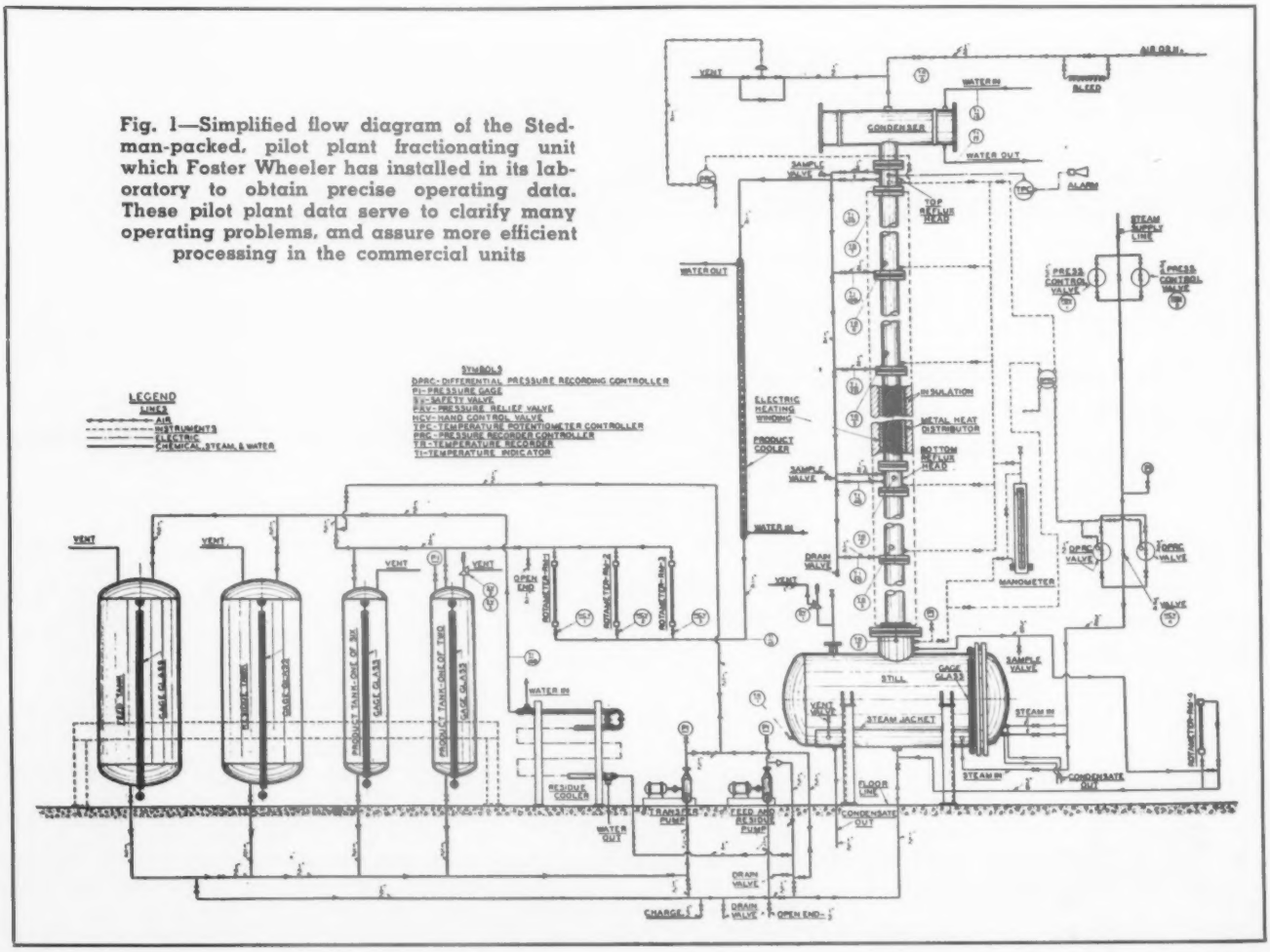

Fig. 1—Simplified flow diagram of the Stedman-packed, pilot plant fractionating unit which Foster Wheeler has installed in its laboratory to obtain precise operating data. These pilot plant data serve to clarify many operating problems, and assure more efficient processing in the commercial units

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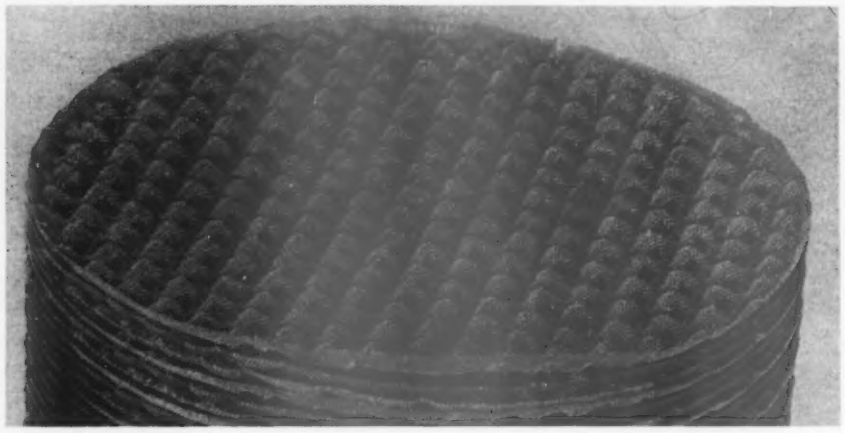

Fig. 2—Section of the Stedman packing, illustrating the pattern of pyramids, vapor openings, valleys and side slip which produce high separating efficiency

paths. When the wire screen constituting Stedman packing is wetted with liquid, a film forms over the entire screen including the open spaces. This film forms on both sides of the screen.

If the wetted surface is slightly inclined and more liquid is fed on to the screen at the higher level, an even flow of liquid over the screen surface (top and bottom) results. Stedman packing is comprised of a great number of such screen areas arranged in exact geometric pattern (see Fig. 2) to produce extensive surfaces of flowing liquid. Positive vapor flow over and around these surfaces is established through a systematic arrangement of vapor passageways. These combinations of design features result in a veritable honeycomb of descending reflux surfaces with which the ascending vapor makes innumerable contacts.

The separating efficiency of Stedman packing is well established. Its ability to separate individual hydrocarbons (and other compounds) of 99% plus purity has been demonstrated in the laboratories of many of the leading chemical and oil companies, and in research bureaus of the government.

The pilot plant column containing 16 ft. of Stedman packing has, under usual operating conditions, about 100 theoretical plates. For convenience sake it is given a 100 plate rating, at which condition the H.E.T.P. (height equivalent to a theoretical plate) is 1.92 in. A column of 100 plates is adequate to handle most of today's fractionating problems, and, in fact, is more than enough for many separations.

From the data shown graphically in Fig. 3 a quick approximation can be made of the minimum number of theoretical plates necessary to effect different degrees of separation from different types of charges.

This graph shows the relationship between (a) the degree of purity required in the fractionation of the more volatile components of an equimolal mixture of two components, (b) the minimum number of theoretical plates required, and (c) the difference in boiling points of the two components of the charge.

For example: (a) The boiling point difference between butane and *iso*-butane is 9.44° C.; to produce an iso-butane of 99.9% purity from an equimolal mixture of these two hydrocarbons would require a minimum of 27 theoretical plates. (b) The boiling point difference between Octane and *iso*-octane is 26° C. and from an equimolal mixture of these two hydrocarbons an *iso*-octane of 99.9% purity may be separated with a minimum of 10 theoretical plate. (c) 100 theoretical plates, using total reflux, will separate a 99.9% pure product out of an equimolal mixture of two components having a boiling point difference of 2.4° C.; a 99% purity from a mixture of 1.6° C. difference and a 90% purity from a mixture of 0.8° C. difference. The graph also shows that, for any given difference in boiling point, the required number of plates is roughly doubled from 90 to 99% purity.

In the research and development work on Stedman packing, operating pressures indicated that the differential between

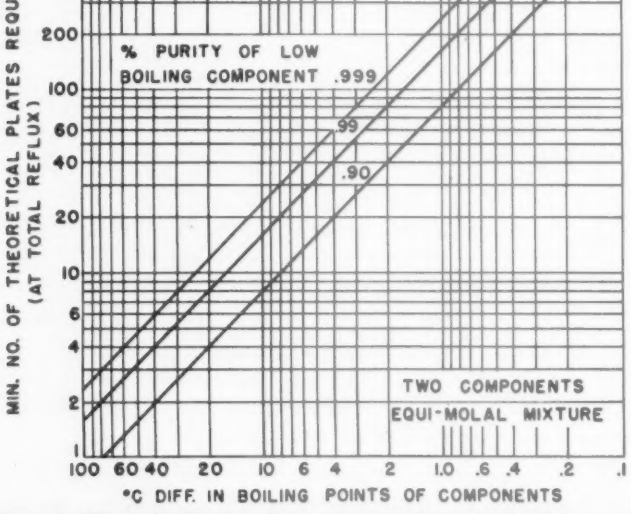

Fig. 3 (Above)—Minimum number of theoretical plates required to separate two components (equi-molal mixture) to various degrees of purity

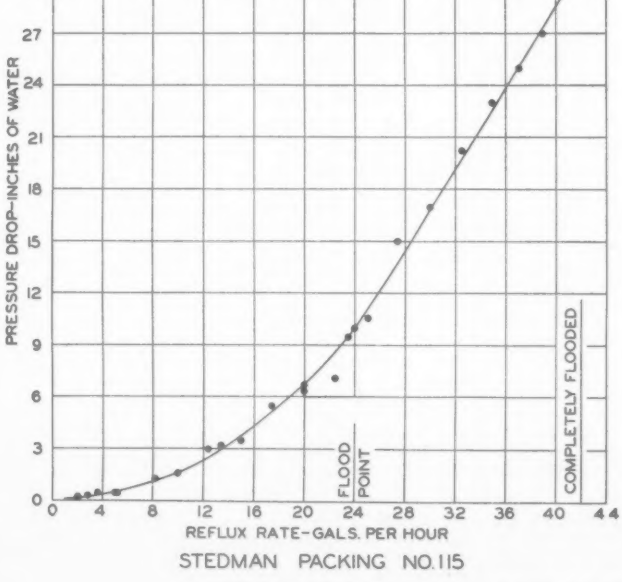

Fig. 4 (Right)—Relationship between pressure drop and reflux rate in Stedman-packed column

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NEW BOOK GIVES A SUMMARIZED PICTURE of Wartime Refining Developments

To help refining technologists serving in the armed forces of their country "catch-up" quickly with the progress in refining technology during their absence, a book—"REFRESHER on WARTIME REFINING TECHNOLOGY" — has been written by the Editorial Staff of the TECHNICAL SECTION, National Petroleum News.

The book is being furnished free to all refining technical men who have been, or are now, in the armed services. Arrangements have been made to reach as many veterans and servicemen as possible through the executive heads of all refining companies in the country. Servicemen not receiving a free copy of the REFRESHER through these channels can get their copies direct from National Petroleum News.

Though the REFRESHER was designed primarily for free distribution to technologists in the armed services, inquiries have already come in asking that it be made available for purchase by other technologists . . . civilian technical men so busy in their particular phase of the wartime refining program that they have been unable to get a clear view of the over-all picture . . . operating men who desire to broaden their knowledge of technical developments . . . men newly entering the field of petroleum refining . . . and men who participated in these history-making developments and want the REFRESHER as a memento.

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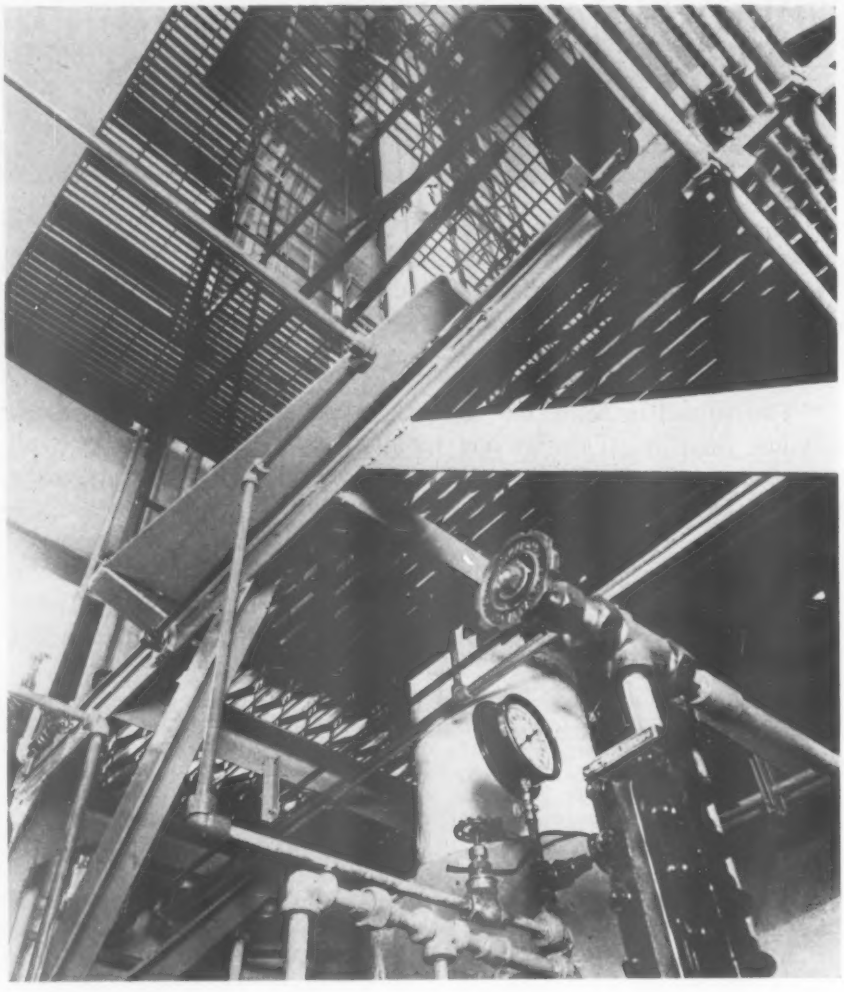
Pilot Unit Segregates Hydrocarbons by Groups



Looking up the 100-plate Stedman column—from still head to condenser

the top and bottom of the column could be utilized to control the permissible throughput rate to the column. This was subsequently found to be so, and inasmuch as throughput rate is a function of heat application, these three operating factors were combined into a simple but effective automatic control in which a predetermined pressure differential actuates the control valve which supplies the heat to the still.

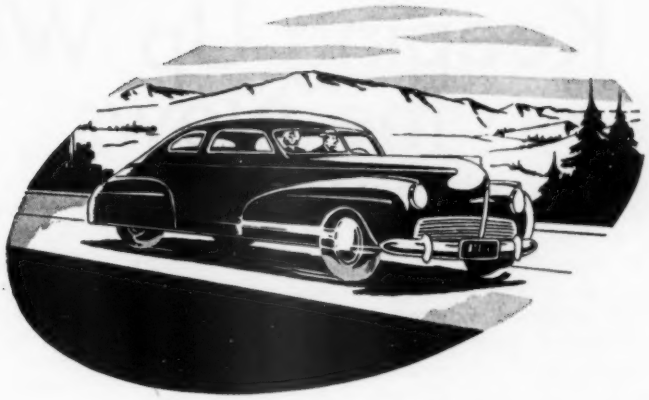
The relationship between these operating characteristics is shown graphically in Fig. 4.

An improved top-of-column temperature control mechanism was also developed. It has great sensitivity, accuracy, and insures maximum yield of desired product with minimum expenditure of heat, while at the same time increasing the sharpness of separation between fractions. In conjunction with the use of this mechanism it is frequently the practice to control top-of-column pressure to avoid errors that would otherwise result from varying atmospheric pressure. One of the unique features of the improved temperature control device is a Klaxon warning given to the operator when the temperature increases above the control temperature, indicating that the column has reached its capacity to separate that product-quality which corresponds to a specific temperature level or range.

Semi or full continuous operation is possible. Connections are made at different points on the column for feed entrance.

The three major purposes that were kept in mind while designing this pilot plant unit are:

1. To provide design engineers with adequate and accurate pilot plant data on the fractionating problem of the moment.
2. To provide operators of fractionating units with precise fractionation data on charging stocks so they may more accurately determine the optimum operating conditions to obtain maximum economy.
3. To disclose, in clearer perspective, the process obsolescence of existing plant distillation equipment and the economic justification for the construction of plant-size, precise fractionation units.



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No industry in the nation employs more technical personnel than does the petroleum industry. Its ramifications are so diverse that the informed person is little surprised to find that postwar aircraft, rocket planes, automobile news, liquefied petroleum gases, hydrogen, and petroleum sulfonates may all be discussed in this article and yet relate to the affairs of the industry.

The author of this series is a chemical engineer in the employ of the research subsidiary of one of the larger oil companies. His duties include a continuous survey of the current technical journals in the many fields now related to the petroleum industry.

Postwar Aircraft

"The rapid fire of aircraft development has stirred the imagination of the public as the Superfortress outstripped the Flying Fortress, as the newest transports dwarfed the airlines' familiar DC-3, and as the engineer's drawing board turned out a succession of designs for tomorrow's huge planes, each more breathtaking in its bigness."(1) "Within two years, or less, air passengers may be traveling almost twice as fast as today, for fares cut by a third or more."(2)

The petroleum industry, obviously, is not the only one interested in the future of aviation, but it is certainly as intimately concerned as any, for its fuels are those upon which the aviation industry has always depended and upon which, presumably, it will continue to depend, whether or not the gas turbine replaces the reciprocating engine. This being the case, there is no doubt of the industry's interest in the types of planes which will populate the postwar skies.

Many of these planes will be civilian models of the huge military and naval transports developed during the war, but others are completely new developments. A recent tabulation of some of these planes is shown in Table I; of these planes, Nos. 2, 3, 4, 5, 7, 8, and 10 have already seen military service. "Others are in various stages of development; and still others, such as the 130-ton Convair C-99, with six engines and 18,000 hp., have not yet progressed even to the point where design drawings can be released for publication."(1)

Some of the details for one of these planes, the Boeing Model 377 "Stratocruiser" (civilian version of the Boeing C-97, which in turn is the military transport version of the Superfortress bomber), will serve to describe something of what may be expected for the future.

Direct operating costs for the Stratocruiser (fuel, pilot's pay, depreciation on the plane) are estimated(2) at from 0.7-1.3 cents per passenger mile, which would permit the plane to fly passengers at a fare of 3-1/2 cents per mile or less (including indirect costs such as landing fields, hangars, maintenance, and employes other than pilots) and still make a profit. Air cargo could be carried at direct costs of 5 cents per ton-mile for ranges of around 1,500 miles and 7 to 8 cents per ton-mile for long hops, thus permitting rates to shippers of 20 cents or less per ton-mile. The Stratocruiser will be able to carry a useful load (crew, gasoline, oil, passengers, and cargo) of about 47% of its 130,000 pounds gross weight. It has a top speed of 380 miles an hour and a cruising speed of 350 miles an hour.

It is certainly not expected, however, that such giants will drive smaller planes from the air. "If airline operation is to grow soundly, the practical utilization of bigger airplanes in transport service must proceed in orderly sequence for three reasons:

"(1) It is better to fly nearly full small planes than nearly empty large ones.—(2) Increasing the size of airplanes for a given volume of traffic tempts the operator to decrease the number of flights over a specific route (thus reducing flexibilty of scheduling). —(3) New types of airplanes must have long periods of service testing in actual airline flying before their operators learn the best methods of operating and maintaining them."(1)

All planes presently being designed will be powered with the conventional reciprocating engines, but some engineers believe that the gas turbine is a "distinct possibility" for 5 years after the war, or even sooner. Whatever the power plant, however, liquid fuels will be required, but the petroleum industry would certainly like to know whether these will be 100+ octane gasolines or kerosine-type distillates.

Rocket Planes

Some recently-revealed data on German rocket planes is of importance in connection with the petroleum industry's interest in post war aviation fuels. A British source(3) reports that the fuel for the German Me163 fighter, the first liquid-rocket power, jet-type airplane, is believed to be composed 80% of concentrated hydrogen peroxide and 20% of methyl alcohol, ignited by a calcium permanganate catalytic detonator.

Although the plane possesses a considerable margin of speed over other aircraft, including contemporary turbo-jet-propelled machines, its fuel consumption—about 1,000 pounds per minute at full thrust—is a serious disadvantage, since it gives the plane extremely short flight endurance.

The same source states that an alcohol-liquid oxygen rocket fuel powers the V-2 rocket bomb, whose

(1) Anon., *Business Week*, No. 807, 21 (1945), "Planes Unlimited."

(2) Cooke, R. P., *Wall Street Journal* CXXV, No. 36, 1 (1945), "Air Travel Trend."

(3) "Minimax," *Petroleum Times*, 49, No. 1240, 84 (1945), "Postwar Aviation Fuels."

TABLE I. Skyliners Which Will Compete for Postwar Business*

Plane	Gross Weight Lbs.	Number of Passengers	Number of Engines	Total Horsepower
1. Martin Mercury 202	33,500	30	2	4,200
2. Curtiss-Wright 20-E (C-46)	48,000	36-42	2	4,400
3. Fairchild C-82	50,000	76	2	4,000
4. Convair 39	64,000	56	4	5,400
5. Douglas DC-4	71,300	49	4	5,800
6. Douglas DC-6	80,500	55	4	8,400
7. Lockheed Constellation	86,250	60	4	8,800
8. Boeing C-97	130,000	72-100	4	8,800
9. Douglas DC-7	162,000	118	4	12,000
10. Martin 170-21 (Mars)	165,000	78	4	12,000
11. Martin Leviathan	250,000	100 and up	6	unknown

*Anon., *Business Week*, No. 807, 22 (1945), "Planes Unlimited."

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speed is believed to approximate 3,000 miles per hour but whose flight endurance, so far, is measured in minutes.

Major Al Williams, in a recent newspaper article, gives some further details of this rocket, stating that "our scientists believe that the V-2 is about 45 to 50 feet long, and about 15 to 17 feet in diameter, with an all up wing of beween 20,000 and 30,000 pounds. The fuel load is approximately 8,800 pounds of alcohol and 13,200 pounds of liquid oxygen. The explosive warhead is estimated at 3,000 pounds, with the rest of the weight total attributable to structure.

"The V-2 presents a striking lesson in the cost of speed (as does the ME163 mentioned above), namely, 400 pounds of fuel consumed per second for a speed of four miles a second. It's the age-old axiom all over again—you can have speed, but you'll pay for it every time. As to the war efficiency of the V-2 (however), we must reserve final opinion until all facts are available after the war."

There is no reason to believe that rocket planes and bombs could not use petroleum distillates instead of alcohols, but that is not the question here. The significant fact involved is that rocket power is not likely to play an important role in postwar commercial aviation, where terrific speed or power will be needed in only a few instances, such as in take-off from restricted areas.

Even jet propulsion, which makes use of oxygen from the atmosphere, seems markedly inefficient from a commercial standpoint, although its brother, the gas-turbine-powered, propellor-driven plane, as mentioned, seems quite attractive.

Nevertheless, the petroleum industry must maintain its interest in such matters. Rocket and jet-propelled planes may be sufficiently developed in time to play an important role in the Japanese war, and it is certain that they will play a very important part in any future war. For its own sake and for the security of this country, the petroleum industry must be prepared to fuel another war, no matter what the fuel required.

Automobile News

The OWI, in a recent report, has predicted that about 1,500,000 cars (nearly 4,000 daily) will disappear from the highways in 1945 and that no new passenger automobiles will be manufactured this year. Quoting ODT, this agency stated that 24,400,000 passenger cars were available on Jan. 1, 1945, of which 23,750,000 are actually in use. It is believed that postwar demands will fall between 12,000,000 and 15,000,000 cars in the first three postwar years. The greatest threat to automotive transportation this year is expected to be a battery shortage, occasioned by the shortage of lead. Repair parts are expected to be fairly ample, although the labor situation is critical.

The automobile industry seems inclined to agree with the OWI that no automobiles will be manufactured this year, even if Germany should be defeated this spring. Everything depends on the share of the industry's capacity which must continue to be devoted to producing material for the Japanese war.

Meanwhile, however, "much preliminary planning for postwar autos is under way. The (Detroit) motor manufacturers list these achievements:

"Minor, face-lifting changes on 1942 models (the latest produced) have been worked out by auto engineers. Known weaknesses in those prewar cars have been studied and corrected, on paper.

"A great deal of other 'paper work' has also been done since last September—in materials specifications for new cars, planning factory layouts and production lines. All this has been accomplished with the 1% of workers which each company has been allowed to devote to postwar work.

"Orders have been placed by most manufacturers for such raw materials as steel, glass, fabrics. Although these are 'unrated' (have no priority), they at least get the auto makers on the raw materials producers' books.

"Conversations have been held with parts suppliers, lining up sources of supplies for various component items which the auto manufacturers normally buy from others."(4)

Among unfavorable factors, however, are the machine tool situation and the "inclination of some government officials to want to continue controls indefinitely over raw materials." This latter factor, it is felt, "would definitely complicate their reconversion problems."

The machine tool situation has been affected by the renewed emphasis on war production. The automobile industry still does not know how many of the machine tools being used for war production they will be permitted to purchase for peacetime use, and the small capacity devoted to the production of new tools for nonmilitary uses has become heavily involved in lend-lease operations.

It would therefore appear that new cars will not be produced in any quantity until sometime in 1946, a whole year later than the optimistic forecasts made last summer. This will certainly have its effect upon postwar demands for gasoline, which will be lower than previously estimated (because of further shrinkage in the number of old cars available).

(4) Anon., *Wall Street Journal* CXXV, No. 46, 1 (1945), "Auto Blueprints."

Liquefied Petroleum Gases

Continued interest has been evidenced, in recent months, in the growth of the liquefied petroleum gases industry, although wartime censorship has served to confuse the statistical analysis of developments. Nevertheless, some recent surveys of this industry have served to point out trends and the healthy growth involved.

According to G. G. Oberfell and R. W. Thomas of the Phillips Petroleum Company(5), total sales of liquefied petroleum gases in 1944 amounted to 18,700,000 barrels, a 16.2% increase over 1944. Domestic sales accounted for 9,340,000 barrels, industrial and miscellaneous for 6,840,000 barrels, gas manufacturing for 1,095,000 barrels, and chemical manufacturing for 1,430,000 barrels; uses in these fields increased 15.5, 18.1, 22.6, and 8.4% respectively.

These figures do not include butane blended with various fractions for motor fuel purposes, liquefied petroleum gas used by the producer at point of production, or sales to synthetic rubber and aviation gasoline plants. Oberfell and Thomas estimated that some 18,200 barrels per day of C_4 hydrocarbons were probably required for the production last year of 350,000 tons of Buna and Butyl synthetic rubbers. It was said that two chemical plants on the Gulf Coast each used about 1,900 barrels per day of liquefied petroleum gases; one of these plants used a C_2-C_3 cut.

James E. Pew and Frank H. Dotterweich have recently stated(6) that 9,260,000 barrels of propane, butane and the butylenes, separately and as mixtures, were used as chemical raw materials in 1943 and that 1944 requirements were estimated at 11,400,000 barrels, not including butane for synthetic rubber and for isomerization to isobutane, uses for these purposes having increased 260% and 270%, respectively, over the same period. It should be noted that the total given for 1944 is much higher than that of Oberfell and Thomas, since it evidently includes gases consumed by the producer and (perhaps) those used for alkylation and polymerization purposes.

According to a paper(7) by Paul K. Thompson, chief of the Liquefied Petroleum Gas Section of PAW's Natural Gas and Natural Gasoline Di-

(5) Oberfell, G. G. and Thomas, R. W. National Petroleum News, *Technical Section*, 37, No. 6, R-108 (1945), "Progress of the LPG Industry During 1944."

(6) Pew, J. E. and Dotterweich, F. H., National Petroleum News, *Technical Section* 37, No. 1, R-11 (1945), "Science in Natural Gas."

(7) Anon., National Petroleum News 37, No. 3, 14 (1945), "Finds Postwar Markets Will Recompense LP-Gas Difficulties."

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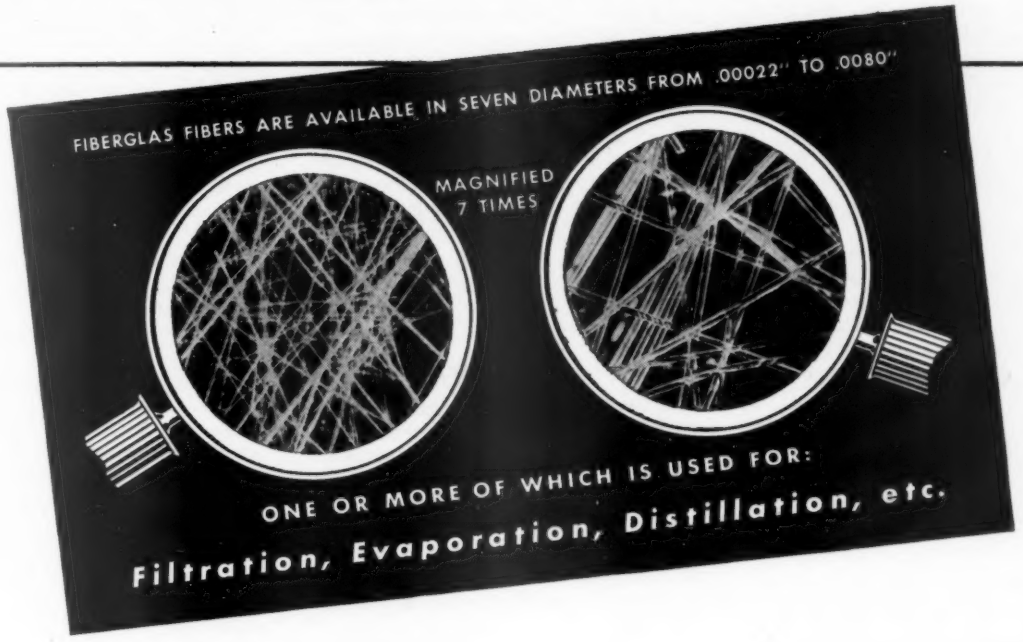
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vision, propane and not butane may be the key component for petroleum chemical manufacturing in the post-war period. "In general, the present trend suggests that acetylene, ethylene, and propylene will be the major components in tomorrow's chemical synthesis. The perfection of processes presently under investigation indicates the use of ethane and propane in ever-increasing quantities as raw materials for the production of these chemical components.

"Naturally, butane will be required as a raw material in many chemical operations, but this demand may not be as exhaustive as predicted by some. Therefore, the return to normal times should see a balanced demand for LP-Gas products, allowing this industry to expand and progress in a reasonably stable and desirable fashion." Thompson's figures were among those quoted by Pew and Dotterweich.

Whatever the actual statistics may be, there can be no doubt that liquefied petroleum gases will play an important part in the postwar era, both as fuels and as raw materials for chemical synthesis.

Hydrogen

A recent bulletin issued by the Bureau of Foreign and Domestic Commerce[8] serves to emphasize some recent developments in the production of hydrogen. This chemical is used by the petroleum industry in the production of hydrodimers and hydrocodimers, in the treating of olefinic naphthas produced by catalytic cracking, in isomerization, and (potentially) in the destructive hydrogenation of heavy distillates and residues.

The bulletin points out that "production in the United States has increased considerably in the past ten years, particularly since the beginning of the war, principally for the manufacture of ammonia." Figures given show that 17,593 million cubic feet were produced in 1941, 21,214 million cubic feet in 1942, and 22,960 million cubic feet in 1943.

In discussing production methods, the bulletin lists: (1) the reaction of coke with steam, followed by removal of nonhydrogen constituents; (2) the thermal decomposition of natural gas; and (3) the electrolysis of water. For some reason, the very important methane-steam reaction was not mentioned, although this process accounts for a large proportion of low-cost production, as does method (2).

Hydrogen is extensively used in the hydrogenation of vegetable and animal oils (for the production of shortenings, soaps, and lubricants), for welding and cutting of metals (in combination with oxygen or air), for the production of hydrochloric acid (by reaction with chlorine), for methanol synthesis (by reaction with carbon monoxide), and for many other chemical syntheses.

The petroleum and natural gas industries are particularly well situated to produce hydrogen at low costs (perhaps 10-25 cents per 1000 cubic feet, without compression, which in turn might cost 5-10 cents per 1000 cubic feet for compression to 3,500 p.s.i.). Their raw materials, high-methane-content natural and refinery gases, are cheap and abundant. It may certainly be expected that more hydrogen will be produced from these materials and used by the petroleum industry in numerous ways, perhaps even in the synthesis of "petroleum" itself via the Synthine process.

(8) Arrington, L. G., *Hydrogen, Synopsis of Information*, Inquiry Reference Service, Bureau of Foreign and Domestic Commerce, United States Department of Commerce (Washington), 1944.

Petroleum Sulfonates

A recent news item[9] indicates that British interests are also entering the field of petroleum chemical derivatives. "A by-product now in production at a British oil refinery is a mixture of oil-soluble sulfonates, marketed under the name 'Petromor 276.' It can be produced free from inorganic salts and alcohol under controlled conditions, to give a standard material. The 'utility' grade being made contains 50% of sodium sulfonates of petroleum fractions, 10% of water, and the rest of mineral oil.

"The material lowers interfacial tension between oil and water, has foaming and dispersing properties, and can be used in both oil-in-water and water-in-oil emulsions. The product is finding use in the manufacture of leather oils, as a textile assistant, and in the production of wax polishes, auto polishes, coal-tar disinfectants, and special cleansing agents."

Gruse and Stevens, in their recent book[10] mention still other uses for the crude mixed sulfonic acids and their salts. These include use in the splitting of fats, employment in greases as extreme pressure agents, and use as insecticides.

The American petroleum and chemical industries are well aware of the value of these substances, as is instanced by recent Tariff Commission statistics[11]. Even greater use may be expected in the future.

(9) Anon., *Soap and Sanitary Chemicals* 21, No. 1, 57 (1945), "Oil Soluble Sulfonates."

(10) Gruse, W. A. and Stevens, D. R., *The Chemical Technology of Petroleum*, McGraw-Hill Book Company, Inc., (New York), 1942.

(11) Anon., NATIONAL PETROLEUM NEWS, *Technical Section*, 37, No. 6, R-130, "Keeping Up With the News—Synthetic Organic Chemicals."

Letter to the Editor

Questions Reasons for Varying Oil Film Thicknesses

Dear Sir:

We have read with interest the article on "Measurement of Residual Lubricating Oil Film Thickness on Vertical Metal Surfaces" by G. L. Clark, T. D. Parks, and T. W. Culmer, which appeared in the December 6, 1944, issue of the *Technical Section of* NATIONAL PETROLEUM NEWS.

We question the correctness of the second part of the statement on Page R-876 that "Films are retained on chrome-plated steel and copper for a longer time and with greater thickness than on aluminum and brass. It is generally familiar that the latter two may be also the most active catalytically in aiding lubricating oil deterioration."

In the first place, putting copper and brass in different groups appears illogical. Copper[1] is known to be catalytically active in stimulating deterioration of oils. In fact, copper is the generally used catalyst for accelerating oil deterioration. It is employed as catalyst in practically all standard oil deterioration tests. Brass is an alloy high in copper and generally has a similar catalytic behavior.

In contrast to this, other workers[2, 3] have generally found that aluminum has little or no catalytic activity in stimulating the decomposition of oils. Aluminum parts have actually been used[4] in oil testing equipment because aluminum was catalytically inactive.

It would seem to us that the greater thickness of the oil films on the aluminum must be due to some other cause than that ascribed by the authors

Very truly yours,

R. B. Mears and D. W. Sawyer
Chemical Metallurgy Division
Aluminum Research Lab.
ALUMINUM CO. OF AMERICA
New Kensington, Pa.

(1) Larsen & Armfield—*Ind. & Eng. Chem.* 35, 582, 1943.
(2) Hunter, Ambrose & Powers—*Power*, May, 1939.
(3) Sawyer & Mears—*Ind. & Eng. Chem. Analyt. Ed.* 17, 3, 1945.
(4) Waters, Larson and Borus—*Technical Section, National Petroleum News* 36, R-176, 1944.

Data on Thermal Expansion of Liquid Hydrocarbons Helpful in Field Studies

A SET of tables and report of an experimental method for determining thermal expansion characteristics of high-pressure liquids from gas-condensate wells has recently been published by the U. S. Bureau of Mines. The information will be useful to operators of condensate wells, cycling plants and engineers engaged in production studies of condensate reservoirs; also to others facing similar problems in other industries. The work was an outgrowth of the Bureau's continuing investigation of gas-condensate reservoirs in the Grapeland and Opelika fields of Houston and Henderson Counties, Texas.

The gap in technical literature became apparent to the Bureau's scientists during determinations of fluid composition from individual wells as cycling operations progressed, when it was desired to compare separator liquids. Temperatures and pressures at which the gas was discharged from the separators often differed from those under which the liquid volumes were determined. To permit accurate determination of gas: liquid ratios observed gas and liquid volumes had to be reduced to equivalent volumes at some "standard" temperature.

After completing the investigation of thermal expansion of representative samples of the liquids taken, it was decided to publish the information ahead of the original, uncompleted research. These factors and the method of their determination are contained in Report of Investigations 3772, "Thermal Expansion of Pressure Samples of Hydrocarbon Liquids from Gas-Condensate Wells," by R. Vincent Smith, M. A. Schellhardt and E. J. Dewees, all of the petroleum experiment station at Bartlesville, Okla.

These tables will find application in many of the cycling industry's problems. For example, some cycling plants pay royalties to gas owners on the basis of the amount of liquids separated in a given period. Since it is not uncommon that wells will produce at different temperatures even from the same pay, and separator temperatures and pressures may differ from well to well, the use of thermal expansion factors to reduce observed volumes to some arbitrary standard (in this report 60° F.) will simplify the computations involved.

Another application will be in the comparison of effluent from one or more wells in the same or different pays as an end to conservation studies, or perhaps in evaluating different techniques or equipment used in production.

Still another application will be the use of the data in determining the economic life of a field, and probable ultimate recoveries. Reservoir temperatures as high as 280° F. are known, while the effluent fluid may be measured at 160° F. or below. The field may have been inefficiently produced in its early days, so that the phenomenon of retrograde condensation has taken place in the reservoir; thermal expansion factors may be used in calculations to estimate the volume of liquid remaining under given conditions, and for further estimates of liquid recoverable after reservoir pressure has passed beyond the conditions under which retrograde condensation is possible.

The report consists of a discussion of data obtained from a study of thermal expansion of 13 hydrocarbon liquids in the range 60 to 160° F. under various pressures. Saturation pressure, the minimum required to maintain a multicomponent mixture in the liquid phase at any given temperature, ranged from 200 to 2000 psia at 160° F. for the liquids studied.

The following information is taken from selected portions of the report:

Description of Apparatus

The apparatus used for determining thermal expansions of liquids taken from separators is illustrated schematically in Fig. 1. The internal volume of sight gage B, containing the sample of separator liquid and mercury, is approximately 89 cc at atmospheric pressure and 60° F. The volumetric capacity of the gage changes with pressure and temperature, and the increase in volume resulting from an increase in internal pressure or temperature was determined by calibration.

Flexible steel tubing D permits the sight gage B to be rocked through an angle of 120°, so that the mercury inside the gage will agitate the fluid and quickly establish equilibrium conditions within the sample at the desired test pressure. The sight gage was calibrated by withdrawing measured volumes of mercury and observing the top of the mercury meniscus with a detachable level-reading scale. The observed volume of the contained liquid is corrected for the "stretch" of the gage resulting from the increased pressure and its thermal expansion.

Pressures in the apparatus were determined by means of calibrated Bourdon-tube gage E. All indicated pressure readings are corrected for the mercury head between the level of the mercury meniscus in sight gage B and the center of the Bourdon gage. Frequent calibrations of the pressure gage were made with a dead-weight piston gage. Pressures within the apparatus were controlled by forcing mercury into the system by means of pump G through valve A3, or by removing mercury from the apparatus through outlet valve A4. All valves are ⅛-in. needle-valves made of stainless steel.

The samples of separator liquid were taken under pressure by connecting a water-filled, thick-walled, steel container to an outlet below the liquid level of the separator and permitting the separator liquid to displace approximately two-thirds of the water in the container. The valve on the container next to the separator then was closed and the remainder of the water was removed, thus decreasing the pressure in the container and permitting the sample to be transported to the laboratory in two phases at existing temperatures. When preparing to transfer a sample from the container to the thermal expansion apparatus, small quantities of mercury were pumped successively into the container which was rocked through an angle of 120°. Thus the pressure in the container was increased to several hun-

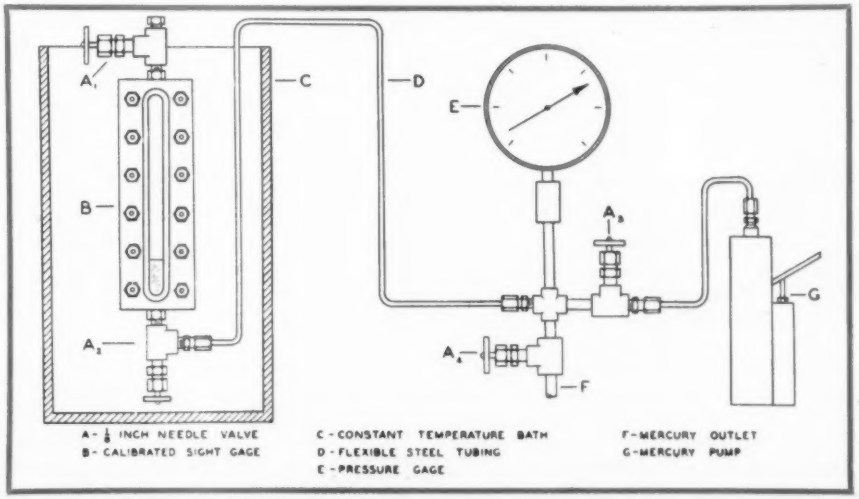

Fig. 1—Schematic sketch of apparatus for determining thermal expansion of separator liquids obtained from gas-condensate wells at high pressures

dred pounds per square inch above the pressure at which the sample was taken.

A homogeneous liquid state in the container was indicated when continued injection of mercury produced a pronounced increase of pressure that could not be reduced by subsequent agitation of the sample. Before transferring the sample to the thermal expansion apparatus, the entire apparatus, including a flexible steel tube between valve A1 and the sample container, was completely filled with mercury under the pressure at which the transfer was to be made. The homogeneous liquid in the container then was forced into the thermal expansion apparatus by simultaneously pumping mercury into the sample container and removing mercury from the expansion apparatus through outlet F. The position of the hydrocarbon-mercury interface in sight gage B indicated the volume of the sample in the apparatus.

Determination of Saturation Pressures and Compressibilities

Saturation pressures and compressibilities of the separator liquids were determined simultaneously after the liquid in the calibrated sight gage had been stabilized at the temperature of the surrounding constant-temperature water bath. The pressure then was reduced by stages of approximately 100 psi or less, by withdrawing small volumes of mercury (not more than 1 cc at a time) from the apparatus. Equilibrium conditions in the apparatus then were reestablished by alternately rocking the sight gage through an angle of 120° and agitating its contents by shaking before the resultant pressure was recorded.

Observed pressures and corresponding liquid volumes were plotted on a chart. Two curves of different slopes were required to define the overall relationship between pressure and volume as the relationship between them at pressures above the saturation pressure was distinctly different than after a gas phase had been formed in the sight gage. The saturation pressure of the liquid at the test temperature was assumed to be the pressure indicated by the intersection of the two curves.

Thermal Expansion Determination

Before the thermal expansion determinations were begun, the pressure and temperature of the fluids in the sight gage were brought to desired test pressure and a temperature of 60° F. After about 30 minutes of intermittent rocking and shaking, if the pressure in the sight gage had not changed—indicating equilibrium conditions within the gage and absence of leaks in the system—a thermal expansion determination was begun by increasing the temperature of the system 20° F. while maintaining the test pressure constant by withdrawing mercury until a state of equilibrium was again reached.

Increasing the temperature of the system by increments of 20° F. then was continued (until the apparatus reached a temperature of 160° F.) for a series of test pressures above the saturation pressure of the sample at the highest temperature of the experimental range. A consideration of the volume of mercury withdrawn from the apparatus for progressive increases of temperature (corrected for the thermal expansion of the apparatus, the expansion of the mercury remaining in the apparatus, and the effect of pressure on the volume of mercury withdrawn) determined the thermal expansion of the liquid in the sight gage at the pressure of the experiment.

A part of the gas in solution in the initial samples of the separator liquids was removed from solution in the samples by differential liberation, forming liquids designated in the report as reduced liquids. The reduced liquid designated Ga-2, for example, resulted from the partial liberation of gas from separator liquid Ga-1 (after all saturation-pressure and thermal-expansion determinations had been completed) by removing mercury from the thermal-expansion apparatus through valve A4 until a gas phase formed in the upper part of the sight gage. The predetermined volume of the gas thus formed then was released through valve A-1. Subsequently, liquids Ga-3, Ga-4 and Ga-5 were formed by successive liberations of solution gas from liquids Ga-2, Ga-3 and Ga-4, respectively. Reduced liquids from samples Gd-1 and Op-1 were formed by similar procedures. The volumes of gas liberated from the liquids were such that the saturation pressures of the liquids in the sight gage were reduced in approximately equal increments from their initial pressures to atmospheric pressure.

Properties of Separator Liquids

The samples of separator liquids discussed in the report were taken by water displacement from separators in the gas-condensate recovery systems under normal operating pressures ranging from 1500 to 1900 psi and at temperatures ranging from 90 to 140° F. Samples designated Ga-1 and Gd-1 were liquids produced from individual wells in the Grapeland field, and sample Op-1, taken from a separator on the inlet to the condensate recovery plant in the Opelika field, was a mixture of the condensate (liquid hydrocarbons) from all wells in the field. Properties of these samples are shown in Table 1.

The volume of gas in solution in the liquids and the shrinkage of the samples when the gas came out of solution (Table 1) were determined by differential liberation tests conducted at a temperature of 122° F. The gases liberated from solution in the separator liquids were analyzed by low-temperature frac-

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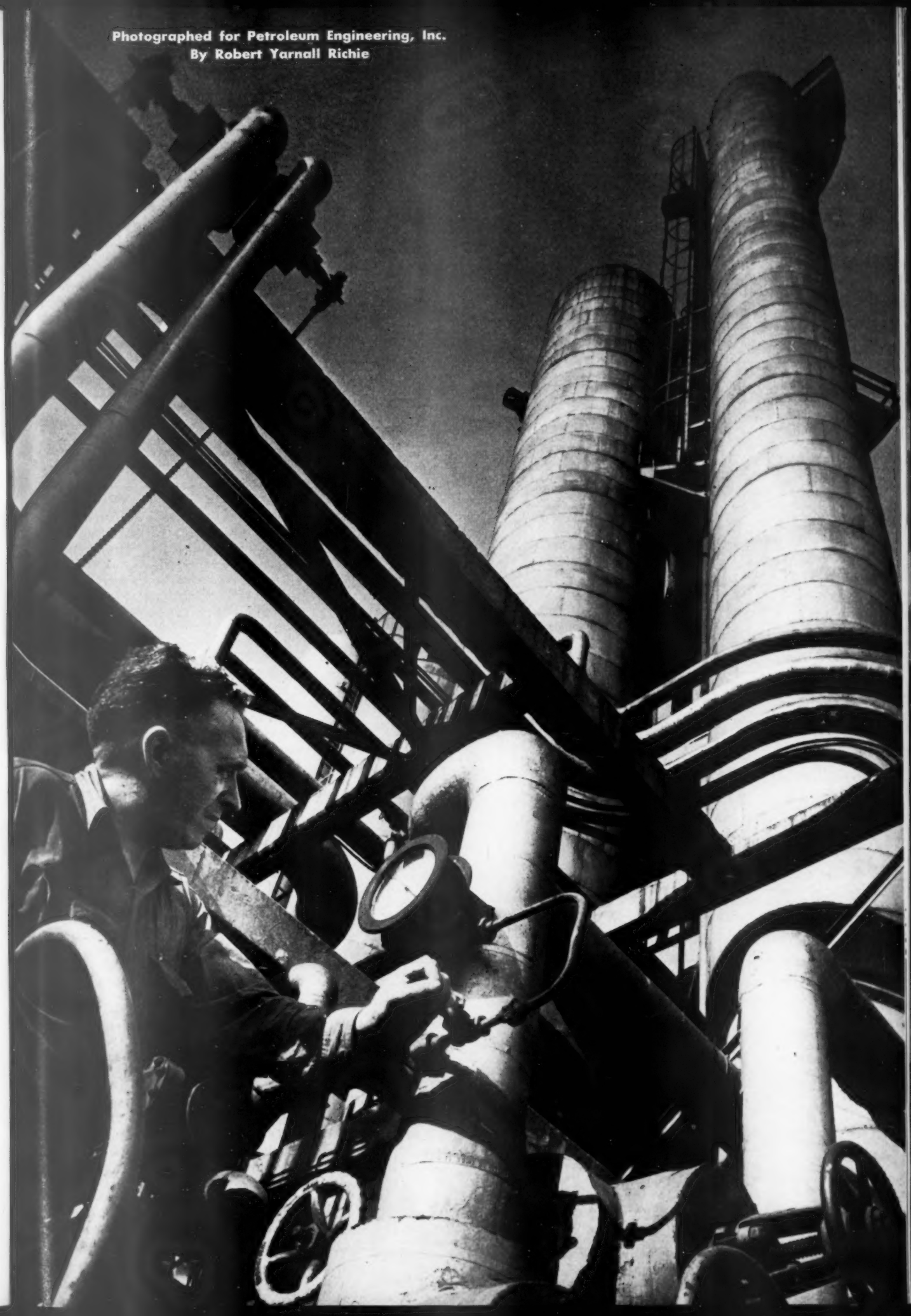
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By Robert Yarnall Richie

TABLE 1—Properties of the Three Separator Liquids from the Grapeland and Opelika Fields, Texas

	Ga-1*	Gd-1†	Op-1‡
Separator pressure, psia	1877	1598	1730
Separator temperature, °F.	138	102	92
Saturation pressure separator liquid at 122° F., psia	1740	1697	1877
Gas in solution in separation liquid, cu ft per bbl residual oil (liberation temp. 122°F.)	1385	1920	930
Shrinkage, bbl separator liquid equivalent to 1 bbl residual liquid	1.745	2.105	1.616
Specific gravity residual liquid, 60°/60°	.7471	.7344	.7368
Molecular weight of residual liquid	119.0	112.0	127.7
Molecular weight of separator liquid	61.8	55.0	72.2
Specific volume of separator liquid, cu ft per lb at saturation pressure and 122°F.	.0274	.0296	.0287

*Separator liquid from well A-5, Grapeland field, Texas.
†Separator liquid from well D-3, Grapeland field, Texas.
‡Separator liquid from recovery-plant separator, Opelika field, Texas.

TABLE 2—Composition of Liberated Gases and Separator Liquids, Mol-%

	Ga-1		Gd-1		Op-1	
Component	Liberated gas	Separator liquid	Liberated gas	Separator liquid	Liberated gas	Separator liquid
Nitrogen	0.62	0.40	0.50	0.34	0.11	0.06
Methane	61.68	38.19	56.62	38.69	70.14	37.76
Ethane	15.31	9.48	15.70	10.73	12.46	6.71
Propane	12.40	7.66	14.28	9.76	8.06	4.34
Isobutane	2.44	1.53	2.88	1.97	2.67	1.44
Normal butane	4.17	2.55	5.51	3.77	3.09	1.66
Isopentane	1.29	.79	1.79	1.22	1.32	.71
Normal pentane	.89	.57	1.16	.79	.86	.47
Hexanes and heavier	1.20	38.83	1.56	32.73	1.29	46.85
	100.00	100.00	100.00	100.00	100.00	100.00

TABLE 3—Analysis of Residual Hydrocarbon Liquids by Bureau of Mines Hempel Method

	Ga-1		Gd-1		Op-1	
Gravity, °A.P.I.	57.9		61.3		60.5	
Color, N.P.A.	Less than 1		Less than 1		Less than 1	
Temperature, °F.	Percent cut	°A.P.I.	Percent cut	°A.P.I.	Percent cut	°A.P.I.
Up to 122	5.7	92.8	9.5	93.1	7.3	93.1
122-167	7.2	81.3	10.7	80.3	8.7	79.7
167-212	12.6	68.1	17.8	67.2	12.9	69.2
212-257	16.4	59.2	19.4	59.2	13.8	62.9
257-302	14.0	54.2	13.0	54.2	11.7	58.7
302-347	12.0	50.9	10.5	51.1	12.1	55.2
347-392	9.2	48.8	6.3	49.0	8.4	52.3
392-437	7.3	46.5	4.8	46.5	7.5	49.7
437-482	6.2	43.2	3.9†	43.4	5.7	46.9
482-527	3.5*	40.6	...	...	5.1	44.1
Residuum	3.1	36.4	2.8	38.2	6.1	39.6
Distillation loss	2.8	...	1.3	...	.7	...
	100.0	...	100.0	...	100.0	...
Approximate summary						
Light gasoline	25.5	76.9	38.0	76.9	28.9	77.8
Total gasoline and naphtha	77.1	61.0	87.2	63.7	74.9	65.0
Kerosene distillate	17.0	44.1	8.7	45.2	18.3	47.2

*End point 525° F. †End point 480° F.

TABLE 4—Saturation Pressures of Separator Liquid Samples and Their Reduced Liquids

Sample Description	Designation	Saturation pressures at indicated temperatures pound per square inch, absolute 60°F	80°F	100°F	120°F	140°F	160°F
Separator liquid	Ga-1	1425	1533	1634	1731	1820	1900
1st reduced liquid	Ga-2	1155	1245	1330	1419	1502	1584
2nd reduced liquid	Ga-3	714	776	839	902	962	1022
3rd reduced liquid	Ga-4	411	451	490	529	566	605
4th reduced liquid	Ga-5	152	175	198	220	244	270
Separator liquid	Gd-1	1392	1498	1597	1689	1772	1850
1st reduced liquid	Gd-2	1177	1265	1354	1438	1519	1591
2nd reduced liquid	Gd-3	725	795	861	920	980	1035
3rd reduced liquid	Gd-4	312	347	383	422	459	493
4th reduced liquid	Gd-5	175	205	233	261	288	314
Separator liquid	Op-1	1559	1666	1770	1868	1955	2034
1st reduced liquid	Op-2	694	753	807	859	907	952
2nd reduced liquid	Op-3	395	430	464	501	535	571

tionation, and their analyses are given in Table 2. Gas analysis data were used with the corresponding solution-gas: Residual liquid ratios to calculate the composition of the separator liquids.

Analyses by the Bureau of Mines Hempel method of the residual hydrocarbon liquids remaining after dissolved gases had been liberated are reported in Table 3. Molecular weights, determined by the cryoscopic method[1], and specific gravities of the residual liquids appear in Table 1. Molecular weights of the original separator liquids were calculated from the compositions of the liberated gases, ratios of liberated gas to residual liquid, and the molecular weights of the residual liquids.

Isobaric determinations of the thermal expansion of hydrocarbon liquids containing gas in solution necessitate carrying out the tests at pressures equal to or above the highest saturation pressures of the liquids throughout the range of experimental temperatures. In conducting the tests, the saturation pressures of all liquids were determined at 60°, 80°, 100°, 120°, 140° and 160° F. before their thermal expansions were determined. Saturation pressures of the liquids at different temperatures were plotted and averaging lines drawn through the experimentally determined points provide means for determining the saturation pressures of the liquids at intermediate temperatures.

The saturation pressures shown in Table 4 are average values taken from such averaging curves. The saturation pressures of the initial liquids (samples Ga-1, Gd-1 and Op-1) were approximately the same; however the wide range of volumes of gas in solution, respectively 1385, 1920 and 930 cu. ft. per bbl. of residual liquid (Table 1) and the widely different compositions of the liquids (Tables 2 and 3) indicate that the three samples represent a wide range of condensate despite the similarity of their saturation pressures.

Isobaric changes in volumes of the liquids with temperature were determined for most of the liquids at several different pressures, and for any constant test pressure the increase in volume of the liquids with increasing temperature was considered to be the result of their thermal expansion. Measurement of the thermal expansion of the separator liquids by volumetric determination of the quantity of mercury withdrawn from the apparatus is believed to be accurate to ±0.02 cc, but measurements of the total (initial) volume of liquid within the apparatus at a given pressure and reference temperature (usually 80° F.) are believed to be accurate to ±0.2 cc (0.3 to 0.6% of the sample volume).

Volume-temperature relationships at lower test pressures for the liquids having low saturation pressures could not be determined with the degree of accuracy obtained in the determinations at higher test pressures or those determined on samples having higher saturation pres-

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sures. In carrying out the experimental work, difficulties were experienced in attaining equilibrium conditions within the apparatus after changing the temperature of the samples. These difficulties probably should not be attributed entirely to the peculiarities of the apparatus, as inability to attain complete equilibrium often has been experienced in other investigations dealing with hydrocarbon liquids characterized by low saturation pressures regardless of the type of apparatus used. Therefore, in determining the effect of pressure upon the thermal expansion of the liquids, less weight was given to the data obtained at low than at higher test pressures.

Correlation of Thermal Expansion and Compressibility

The relationship between volume and pressure at a constant test temperature was determined on the samples of the separator liquids in conjunction with the determinations of their saturation pressures. The changes in the volumes of the liquids were determined by volumetric measurements of the amounts of mercury withdrawn for a given decrease of pressure. Initial (or total) volumes of the samples were determined by the procedure described for determining thermal expansion. Isothermal pressure-volume relationships were plotted, and averaging curves through the plotted data gave a series of approximately parallel curves. Data on the volumes of the samples taken from the pressure-volume curves for a series of pressures covering the range of experimental pressures were used to calculate an independent series of thermal expansion factors.

Examination of the thermal-expansion data for all the liquid samples indicated that in some instances there were slight irregularities in the trend of the effect of pressure upon the thermal expansion factors at a constant temperature; the factors based upon the compressibility data, however, were more consistent with respect to the effect of pressure. The irregularities may be attributed to the fact that the effect of pressure upon the sample volume for the thermal expansion was measured by readings on the level-reading scale; whereas the effect of pressure upon sample volume in compressibility determinations was measured by volumetric determinations of mercury withdrawn from the apparatus.

Thermal expansion factors taken from lines drawn through plotted thermal expansion and compressibility data are given in Table 5. Thermal-expansion factors also were plotted as functions of temperature for constant test pressures. The position of the curves on the charts (omitted) show that under high test pressures, all liquids studied had lower thermal expansions than under lower pressures; they show, also, that the thermal expansion of hydrocarbon liquids is not a straight-lined function of temperature, but increases with increased temperature.

Application of Thermal Expansion Data To Gas-Condensate Recovery Problems

In parts of gas-condensate production and gathering systems where pressures and temperatures are relatively constant, hydrocarbon liquids that may be present generally are considered to be saturated and in equilibrium with the gas phase of the fluid under the prevailing pressures and temperatures. The volumes of hydrocarbon liquids measured in gas-condensate recovery systems under high pressures and temperatures may be reduced to equivalent volumes at a standard temperature by applying the thermal expansion factors for saturated liquids summarized as a function of saturation pressures in Fig. 2. Data are divided into three groups according to the composition and physical properties of the three separator liquids from which the subsequent reduced liquids were formed.

Factors for hydrocarbon liquids whose

TABLE 5—Thermal Expansion Factor for Samples Ga-1, Gd-1, Op-1, and Reduced Liquids

Sample	Test pressures, lb. per sq. in. absolute	Factors for reducing volumes at indicated temperatures to volumes at 60°F. 60°F.	80°F.	100°F.	120°F.	140°F.	160°F.
Ga-1	2500	1.0000	0.9818	0.9638	0.9454	0.9266	0.9070
	2297	1.0000	.9814	.9625	.9433	.9238	.9036
	2093	1.0000	.9809	.9611	.9413	.9209	.8999
	1902	1.0000	.9803	.9599	.9394	.9182	.8966
	1694	1.0000	.9800	.9584	.	.	.
	*	1.0000	.9796	.9585	.9378	.9172	.8966
Ga-2	1594	1.0000	.9813	.9625	.9435	.9241	.9039
	*	1.0000	.9811	.9615	.9426	.9234	.9038
Ga-3	2500	1.0000	.9861	.9716	.9570	.9422	.9274
	2093	1.0000	.9854	.9700	.9544	.9388	.9230
	1715	1.0000	.9848	.9686	.9523	.9359	.9191
	1302	1.0000	.9841	.9670	.9499	.9326	.9150
	1043	1.0000	.9834	.9659	.9481	.9305	.9123
	*	1.0000	.9831	.9651	.9472	.9299	.9120
Ga-4	1715	1.0000	.9869	.9735	.9598	.9454	.9305
	1314	1.0000	.9862	.9720	.9574	.9424	.9267
	912	1.0000	.9856	.9704	.9549	.9391	.9231
	632	1.0000	.9851	.9694	.9532	.9369	.9205
	*	1.0000	.9845	.9687	.9526	.9365	.9204
Ga-5	1715	1.0000	.9874	.9748	.9624	.9498	.9363
	1314	1.0000	.9869	.9735	.9604	.9470	.9332
	912	1.0000	.9864	.9726	.9587	.9445	.9301
	510	1.0000	.9859	.9715	.9567	.9421	.9272
	282	1.0000	.9856	.9708	.9559	.9406	.9252
	*	1.0000	.9845	.9700	.9549	.9402	.9251
Gd-1	2500	1.0000	.9805	.9602	.9394	.9185	.8963
	2297	1.0000	.9798	.9586	.9371	.9147	.8919
	2093	1.0000	.9792	.9571	.9347	.9111	.8875
	1872	1.0000	.9784	.9554	.9321	.9077	.8826
	*	1.0000	.9766	.9534	.9300	.9074	.8822
Gd-2	2500	1.0000	.9819	.9639	.9451	.9257	.9064
	2093	1.0000	.9804	.9606	.9404	.9190	.8978
	1715	1.0000	.9790	.9576	.9355	.9127	.8895
	1616	1.0000	.9783	.9568	.9345	.9111	.8875
	*	1.0000	.9774	.9549	.9321	.9095	.8870
Gd-3	2500	1.0000	.9846	.9684	.9517	.9355	.9187
	1715	1.0000	.9829	.9657	.9480	.9299	.9113
	1314	1.0000	.9821	.9644	.9460	.9264	.9055
	1043	1.0000	.9817	.9636	.9452	.9244	.9025
	*	1.0000	.9816	.9630	.9438	.9238	.9022
Gd-4	1715	1.0000	.9857	.9707	.9555	.9405	.9250
	1314	1.0000	.9848	.9689	.9528	.9364	.9199
	912	1.0000	.9839	.9672	.9500	.9322	.9143
	510	1.0000	.9829	.9653	.8470	.9281	.9092
	*	1.0000	.9826	.9650	.9465	.9278	.9090
Gd-5	1715	1.0000	.9859	.9716	.9575	.9434	.9286
	1314	1.0000	.9855	.9708	.9560	.9413	.9256
	912	1.0000	.9851	.9700	.9547	.9393	.9228
	510	1.0000	.9848	.9692	.9536	.9371	.9199
	331	1.0000	.9846	.9689	.9530	.9361	.9186
	*	1.0000	.9845	.9686	.9527	.9360	.9185
Op-1	2073	1.0000	.9824	.9637	.9454	.9266	.9073
	*	1.0000	.9814	.9625	.9440	.9255	.9068
Op-2	962	1.0000	.9842	.9680	.9513	.9344	.9172
	*	1.0000	.9837	.9674	.9508	.9342	.9172
Op-3	581	1.0000	.9848	.9691	.9527	.9361	.9196
	*	1.0000	.9845	.9686	.9523	.9360	.9199

*Thermal expansion factors for the saturated liquid at indicated temperatures.

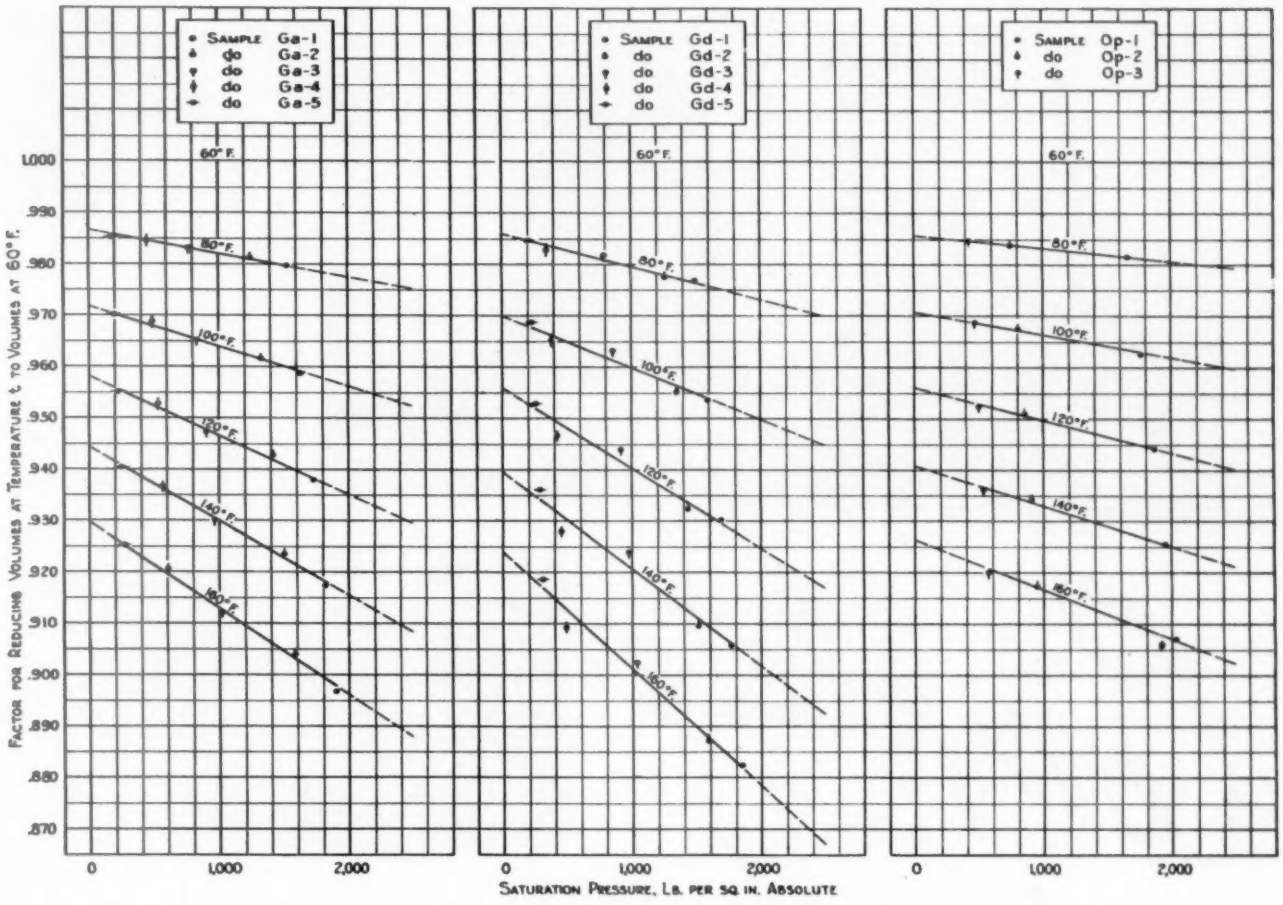

Fig. 2—Relationships between thermal expansion factors and saturation pressures for samples Ga-1, Gd-1, Op-1 and reduced liquids

thermal expansions are unknown may be assumed to equal, for the purpose of field studies of gas-condensate recovery problems, the factors determined experimentally for liquids having similar compositions and physical properties (saturation pressure, specific gravity, etc.).

The compositions and physical properties of the reduced liquids described in the report are not identical with those having equal saturation pressures that would have been formed from the initial liquid under the flash-type liberation that would have occurred in a gas-condensate recovery system. It is probable, however, that the effect of the resultant differences between the properties of the liquids formed under the respective conditions on their thermal expansion factors would be small.

For example, the value of the thermal expansion factor determined for a liquid taken from a separator in the Opelika field operating at a pressure of 400 psi and a temperature of 76° F., which had a saturation pressure of 518 psi at 160° F., was 0.930 at 160° F. The value of the thermal expansion factor estimated from the data for liquids Op-1, Op-2 and Op-3 (Fig. 2) for a liquid having a saturation pressure of 518 psi at 160° F. was 0.922 at 160° F. The difference between the value of the factor determined experimentally and the value of the factor estimated from the data, 0.008 (about 0.9%), probably represents a measure of the effect of the difference between the compositions of liquids formed in the laboratory by differential liberation of gas and liquids formed in gas condensate recovery systems under conditions that may approach flash-liberation.

The data presented in this report may be extrapolated to obtain thermal expansion factors for temperatures beyond the range of the experimental data (60 to 160° F.). Isobaric reduction of the volumes of saturated liquids measured at temperatures lower than 60° to 60° F. (or, from a lower to a higher temperature), for comparison of liquid volumes, would not require evaluation of the saturation pressure and corresponding thermal expansion factor for the liquid at the higher saturation pressure, although the higher pressure would be required to prevent the formation of a gas phase if the temperature of the liquid actually were raised to the standard temperature under the observed pressure.

This conforms to common commercial and engineering practices, which neglect the effect of condensation that might occur if natural gas measured at high temperature corrected to an equivalent volume at a lower temperature actually were measured at the lower standard temperature, and likewise the effect of evaporation that may occur if the temperature of a crude oil that was produced and measured at a lower temperature actually were raised to a standard temperature.

The range of composition of the liquids investigated was too limited to formulate general conclusions regarding the effect of composition upon their thermal expansion. The thermal expansion data presented should prove helpful in a study of many field problems. The referring of volumes of hydrocarbon liquids containing gases in solution measured under pressure to a standard temperature, however, will facilitate the study of problems in many phases of the natural gas and petroleum industries, and the extension of the study to include many separator liquids of different compositions will fill an important need.

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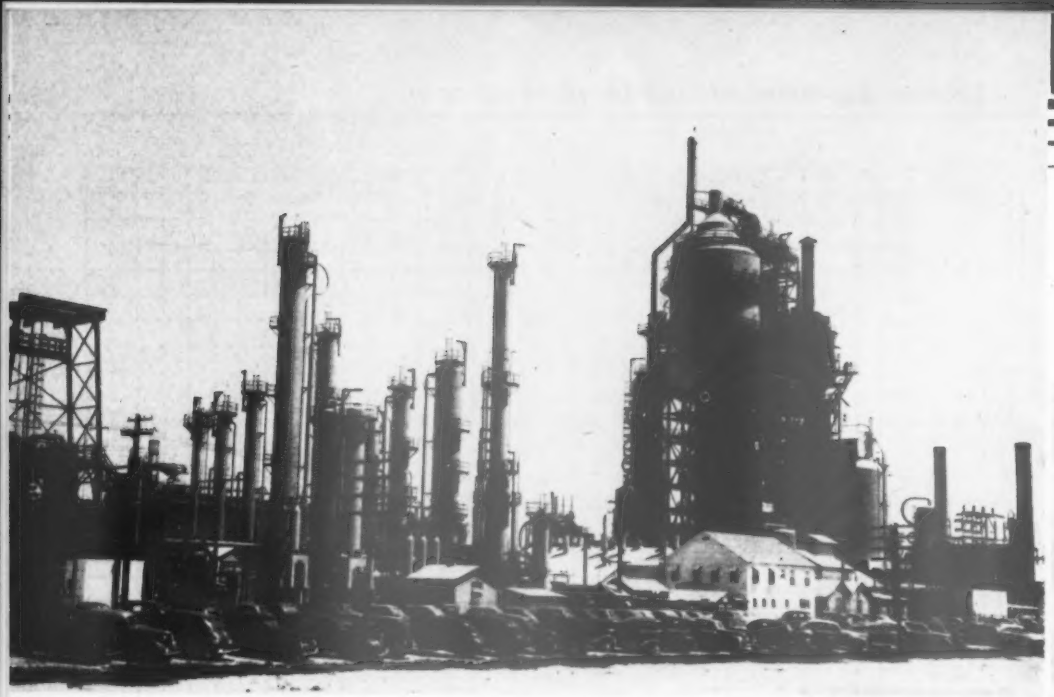

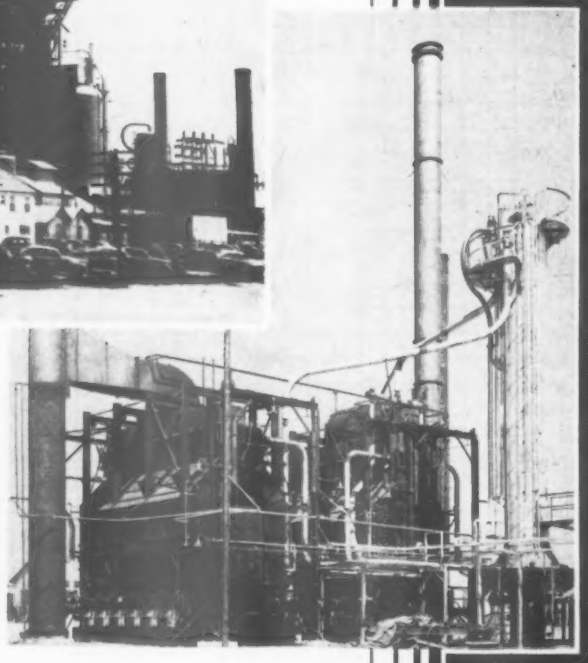

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Hydrocarbon Synthesis from Oxygenated Organic Compounds

Reactions of Some Oxygenated Organic Compounds Over the Cobalt Catalyst Used for Synthesis of Gasoline from Water Gas

By Ya. T. Eidus

(Institute of Organic Chemistry, Academy of Sciences U.S.S.R.)

Author's Conclusions

1. Experiments were carried out by the flow method on chemical conversion at 170-200° of some simple oxygenated organic compounds, such as methyl and ethyl alcohols and formic acid, over a cobalt-thoria-kieselguhr catalyst used for synthesis of gasoline from water gas.

2. In all experiments liquid hydrocarbons were obtained resembling in properties gasoline obtained over the same catalyst from mixtures of one volume carbon monoxide and two volumes hydrogen.

3. The decomposition of methyl alcohol is described by $CH_3OH \rightarrow CO + 2H_2$. The rate of decomposition increases with rise of the temperature and the amount of methanol converted reached 61.2%.

4. The yield of liquid hydrocarbons from methyl alcohol, calculated per unit volume of the gas obtained by decomposition of methanol as described above, is considerably lower than the yield of gasoline directly obtainable from the mixture $CO + 2H_2$.

5. The experimental data obtained revealed that formation of methyl alcohol as an intermediate product of gasoline synthesis from water gas is not very probable.

6. Formic acid undergoes under similar conditions complete decomposition in two directions:

$$HCOOH \rightarrow CO_2 + H_2$$

and

$$HCOOH \rightarrow CO + H_2O$$

Carbon monoxide and hydrogen formed in this process are converted to gasoline.

7. Ethyl alcohol suffers only a partial decomposition under these conditions. For the most part this reaction proceeds as follows: $CH_3CH_2OH \rightarrow CH_4 + CO + H_2$.

8. Formation of liquid hydrocarbons from carbon monoxide and hydrogen originally formed is apparently a secondary process.

IN PREVIOUS investigations of the mechanism of catalytic synthesis of gasoline from carbon monoxide and hydrogen it was found that carbides formed by interaction of carbon monoxide with the cobalt catalyst are neither intermediate products[1] nor catalysts in gasoline synthesis[2]. It was also established that methylene radicals constitute intermediate products of this synthesis[3].

The last mentioned observation in no way contradicts the theory which assumes formation of hydrocarbons from carbon monoxide and hydrogen through oxygenated compounds. It may be supposed that methylene radicals are actually produced by hydrogenation of carbon monoxide on the surface of the catalyst, through intermediate oxygenated compounds. The mechanism of the process may involve adsorption of carbon monoxide and hydrogen on the surface of the catalyst and interaction to an oxygenated hydrogenation product.

According to A. A. Balandin's multiplet theory of catalysis[4], this may be expressed as follows:

$$\begin{matrix} O & \cdot & H & & O{-}H \\ \| & & | & \rightarrow & | \\ C & \cdot & H & & C{-}H \end{matrix} \quad \ldots\ldots\ldots (1)$$

If it is assumed that the active centers of the doublet are cobalt atoms, it is seen[5] that the process will consume 32.5 kilocal. per mole ($E_{H-H} \approx 0$):

$$E = Q_{Co-H} + Q_{Co-O} - Q_{C \neq O}$$
$$= 15 + 70 - 235/2 = -32.5$$

The adsorbed product of hydrogenation[1] can undergo further hydrogenation as follows:

$$\begin{matrix} H & \cdot & O{-}H \\ | & & | \\ H & \cdot & C{-}H \end{matrix} \rightarrow H_2O + CH_2 \quad \ldots\ldots (2)$$

and the consumption of energy will be the same as in reaction (1). Thus a single molecule of carbon monoxide and two molecules of hydrogen give one methylene radical and one molecule of water:

$$CO + 2H_2 \rightarrow CH_2 + H_2O \quad \ldots\ldots (3)$$

This brings into agreement the theory of intermediate formation of methylene radicals with the theory of intermediate formation of oxygenated compounds, excluding carbide formation in the synthesis of gasoline from carbon monoxide and hydrogen.

In the light of the above considerations it was of interest to study the behavior of some simplest oxygenated compounds over a catalyst used for gasoline synthesis. Conversion of vapors of methyl alcohol and formic acid over a cobalt-thoria catalyst carried on kieselguhr was studied in this work. Some data pertaining to the behavior of ethyl alcohol in this type of conversion are also reported.

Decomposition of methyl alcohol

$$CH_3OH \rightarrow CO + 2H_2 \quad \ldots\ldots (4)$$

attracted special attention among its thermal[6] and catalytic[7] reactions. It was investigated on different catalysts[8], [9], mainly with a view of finding suitable catalysts for preparation of methanol from carbon monoxide and hydrogen under elevated pressure.

It was observed that decomposition of methanol at 185-210°C. over the nickel contact used for gasoline synthesis involves conversion of a portion of the methanol into liquid hydrocarbons. Similar results were also obtained in experiments with formic acid over the same contact[10]. Catalytic decomposition of formic acid in vapors and solutions was investigated over various contacts by a number of authors[11], and the original results of Sabatier[12] were confirmed according to which three directions of the reaction are possible:

$$HCOOH \rightarrow H_2 + CO_2 \quad \ldots\ldots (5)$$
$$HCOOH \rightarrow H_2O + CO \quad \ldots\ldots (6)$$
$$2HCOOH \rightarrow HCOH + CO_2 + H_2O \quad (7)$$

Along with catalysts directing the decomposition predominantly in one of these ways (dehydrogenation, (5), over palladium, platinum, copper or nickel; dehydration, (6), in the presence of titanium dioxide and tungsten pentoxide) catalysts of mixed action are also known. For instance, thoria directs the process toward the three reactions and the reaction (6) accounts for 79% at 230°C.

Experimental Part

(In collaboration with T. L. Fedichkina)

The previously described[1], [2] catalyst containing cobalt-thoria precipitated on kieselguhr was used in this work. The weight of the dry catalyst before reduction was 28 g. (10 g. cobalt). It formed a layer of 44 cm. It was reduced with electrolytic hydrogen at 375° for 17 hours.

Methyl alcohol. Methyl alcohol was first freed of acetone and moisture[13], after which it showed a boiling point of 64.6° at 760 mm.; $d(15/4)$, 0.7971; $n(20/D)$, 1.3294 (content of methanol[14], 99.6%).

The experiments were carried out by the flow method. The alcohol was charged from a Balandin buret into a 14 mm. diameter glass reaction tube at a constant rate. The undecomposed methanol and products of its decomposition were directly collected in a receiver at room temperature and in a coil trap cooled with solid carbon dioxide in acetone. The uncondensed reaction gas was charged to a gasometer and analyzed.

The experimental data are shown in Table 1. The reaction temperature was within the interval characteristic for the formation of gasoline from carbon monoxide and hydrogen over cobalt as a catalyst (170-200°). Experiments 1-5 were carried out with the same portion of the catalyst and the experiments 6-8 with a different portion of the same catalyst prepared simultaneously with the former.

The weight of the reacted alcohol was

This article is the third in a series of translations from Russian scientific literature, which are being published in the TECHNICAL SECTION of National Petroleum News with the cooperation of the Petroleum Division of the American Chemical Society.

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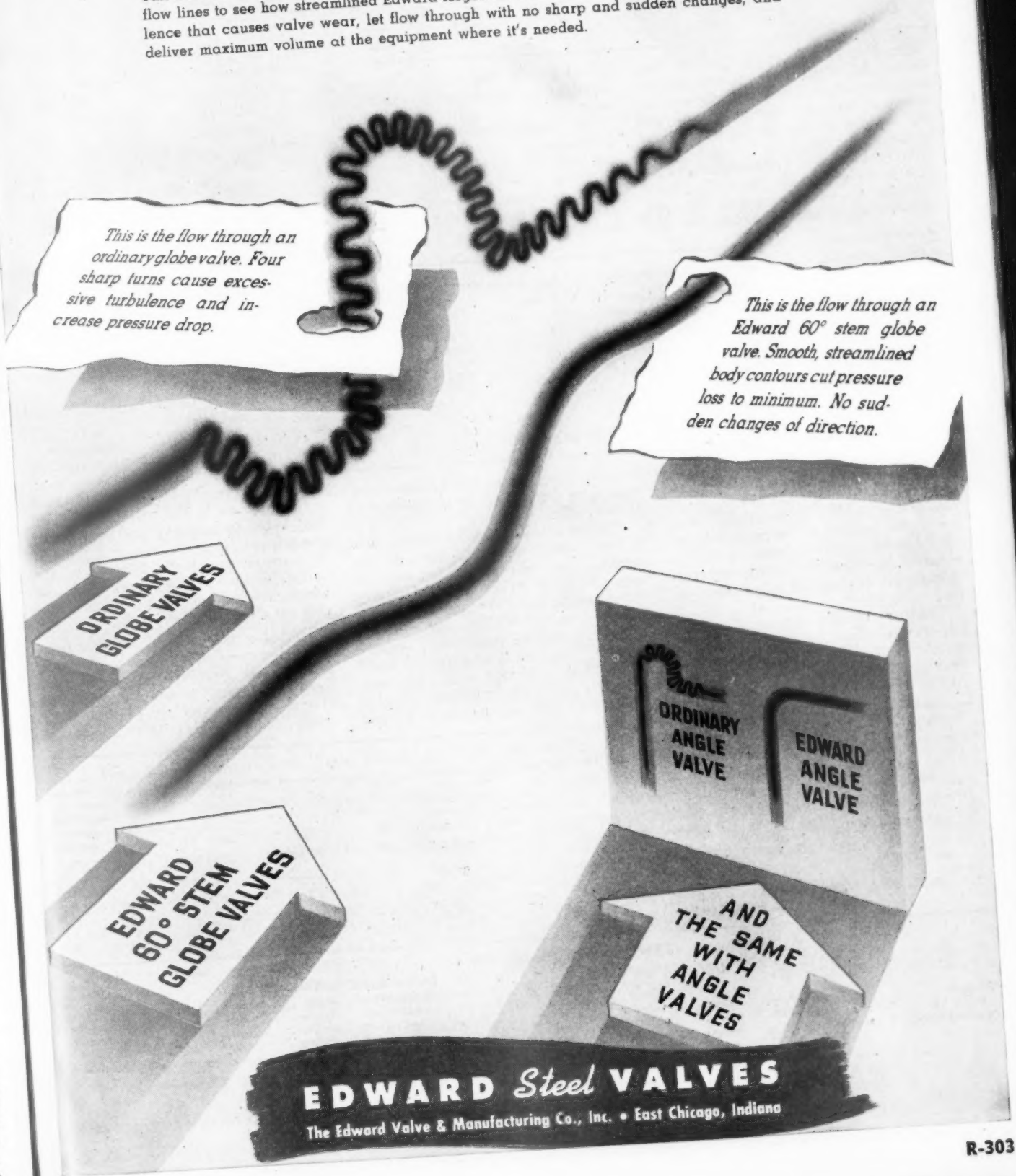
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TABLE 1—Experiments with Methyl Alcohol

Expt. No.	Carrier Gas	Experimental Temperature C	Reaction Time, Hours	Space Velocity of Methanol	G. Methanol Passed	Per Cent by Wt. Methanol Reacted	Yield of Liquid Hydrocarbons, Per Cent on the Reacted Methanol	Yield of Liquid Hydrocarbons, Ml. per Cu. M. Initial Gas	Average Space Velocity of the Gases	Average Space Velocity of the Carrier Gas	Ratio of the Volumes of Oil and Gasoline
1	H_2	200	51.7	0.05	136.8	61.2	32.5	95.7	50.7	16.7	1.2
2	H_2	180	36.5	0.04	74.7	29.9	25.0	50.7	27.1	14.4	1.2
3	N_2	180	21.7	0.04	42.3	32.0	0.0	0.0	25.5	4.3	...
4	N_2	200	35.2	0.04	69.8	30.9	16.9	46.3	18.5	5.8	...
5	H_2	200	13.0	0.03	21.1	38.0	...	53.3	19.3	5.2	3.5
6	..	170	16.0	0.03	29.7	12.6	0.0	0.0	...	....	...
7	..	180	22.5	0.035	42.4	19.5	7.4	20.2	11.4	....	...
8	..	200	60.5	0.03	112.4	39.1	18.6	52.1	22.5	....	5.0

determined from the difference between the weights of the alcohol passed and that remaining unreacted. The latter was determined from the specific gravity and the volume of the alcohol-water layer of the reaction products.

The yield of liquid hydrocarbons in per cent by weight on the reacted methanol (column 8) was determined from the carbon content, and constituted the ratio of the numbers of g.-atoms of carbon contained in the gasoline and in the reacted alcohol multiplied by 100. In the calculation of the yield of hydrocarbons in ml. per cu. m. "initial gas" the latter was conceived as the gas which would have been obtained if complete decomposition of the reacted alcohol had taken place according to equation (4).

The space velocity of the gas (column 10) was calculated considering the same amount of "initial gas". A comparison of the experiments 1 and 5 reveals that the activity of the catalyst during the reaction period greatly diminished, which can be explained by deposition of paraffin wax on it.

The composition of the emitted gas (excluding air or nitrogen), after freezing out the condensable products, is shown in Table 2. Table 3 reports data on the fractional composition of the hydrocarbons formed, as well as the physical constants and bromine numbers of the individual fractions. The bromine numbers were determined by the method of Kaufmann.

The per cent of reacted methyl alcohol is seen from Table 1 to fluctuate, depending upon the reaction conditions, between 12.6 and 61.2. Over the catalyst tested, methanol is decomposed at temperatures as low as 170° and with rise of the temperature it increased (experiments 6, 7 and 8). The maximum liquid hydrocarbons formed, 32.5%, was reached at 200°, using hydrogen as the carrier gas. This corresponds to a yield of liquid hydrocarbons of 95.7 ml. per cu. m. initial gas at a space velocity of the total gas amounting to 70. With a carbon monoxide-hydrogen ratio of 1:2 the yield of liquid hydrocarbons under the same conditions and at the same space velocity in the presence of 5 g. cobalt as a catalyst amounted to 117 ml. per cu. m.[2].

In an atmosphere of nitrogen, as well as without a carrier gas, the yield on the reacted alcohol dropped to 16.9-18.6%, or to 46.3-52.1 ml per cu. m. at 200°, and a space velocity of 20. Thus, the yield of liquid hydrocarbons in the case of methyl alcohol as a starting material is lower than that obtainable from a readily available mixture of 1 mole carbon monoxide per 2 moles hydrogen.

The observed difference may be due to the fact that a portion of the active surface of the catalyst is occupied by molecules of methanol and consequently does not participate in the synthesis of gasoline. When hydrogen is used as a carrier gas this portion of the surface is reduced in consequence of the increase of the surface occupied by hydrogen molecules which constitute one of the initial materials for the gasoline synthesis.

Thus, the molecules of methanol from which the molecules of carbon monoxide and hydrogen required for gasoline synthesis are formed retard this synthesis. This observation may serve as the basis of an assumption that direct conversion

TABLE 2—Composition of the Gas Emitted in the Experiments with Methyl Alcohol, Per Cent by Volume.

Expt. No.	Carrier Gas	CO_2	Unsaturated Hydrocarbons	CO	H_2	CH_4
1	H_2	2.1	0.9	16.9	76.9	3.2
2	H_2	0.7	0.2	7.0	91.0	1.1
3	N_2	2.1	0.3	30.8	66.8	0.0
4	N_2	4.0	0.2	32.4	63.4	0.0
5	H_2	...	...	...	...	...
6	..	2.6	0.1	24.6	62.5	10.2
7	..	4.2	0.2	30.9	61.4	3.3
8	..	4.7	1.5	26.6	63.1	4.1

TABLE 3

Expt. No.	Reaction temperature °C.	Fraction with 150° end point: %	d_4^{15}	n_D^{20}	Bromine number	Per cent unsaturated hydrocarbons	Fraction 150-220° C.: %	d_4^{15}	n_D^{20}	Bromine number	Per cent unsaturated hydrocarbons
1	200	47.5	0.6810	1.3897	36.0	22.5	26.7	0.7499	1.4312	6.1	5.7
2	180	30.0	.....	1.3954	24.3	...	25.0	.	1.4192	4.7	....
3	200	26.9	0.7134	1.4049	38.4	27.4	46.2	0.7667	1.4302	10.4	10.6
					Iodine number					Iodine number	
from $CO—2H_2$	185	41.2	0.6815	1.3875	85.6	31.3	23.0	0.7491	1.4221	14.2	8.0
	200	54.1	0.6868	1.3919	82.5	30.2	15.3	0.7591	1.4255	21.0	12.9

TABLE 4—Experiments with Formic Acid

Experiment number	Carrier gas	Experimental temperature, °C.	Reaction time, hours	Space velocity of formic acid	g. formic acid passed	Per cent by wt. formic acid reacted	Per cent liquid hydrocarbons (gasoline and oil) on the reacted formic acid	Yield of liquid hydrocarbons ml. per cu.m. gas	Average space velocity of the gases	Average space velocity of the carrier gas	Ratio of the volumes of oil and gasoline
1	..	180	74.0	0.035	208.9	99.8	9.4	40.9	42	...	1.4
2	..	200	36.0	0.035	106.3	100.0	8.6	38.6	42	...	0.5
3	H_2	180	40.0	0.035	115.8	99.6	6.1	26.6	42	7.7	0.7
4	H_2	200	38.0	0.035	110.9	100.0	11.1	50.4	42	8.2	0.45
5	N_2	180	42.5	0.036	126.2	99.9	7.1	30.5	42	7.9	1.2
6	N_2	200	62.7	0.036	183.6	99.9	5.1	22.2	42	7.5	0.7

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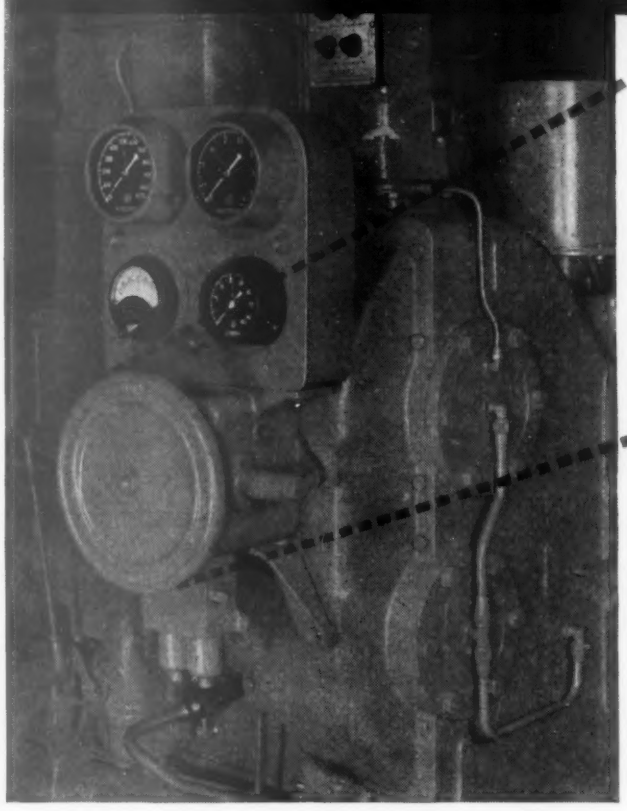

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TABLE 5—Composition of the Emitted Gas in the Experiments with Formic Acid, Per Cent by Volume

Expt. No.	Carrier gas	CO_2	Unsaturated hydrocarbon	CO	H_2	CH_4
1	..	55.6	0.4	19.6	23.2	1.2
2	..	68.5	0.3	8.2	22.6	0.4
3	H_2	41.7	0.2	19.2	38.9	0.0
4	H_2	53.3	1.2	9.4	36.1	0.0
5	N_2	43.5	1.1	23.5	31.9	0.0
6	N_2	56.6	0.5	14.2	28.7	0.0

of methanol into hydrocarbons on the catalytic surface is not very probable. Formation of methanol as an intermediate product in synthesis of gasoline from carbon monoxide and hydrogen is also seen as unlikely.

The data of Table 2 certify to decomposition of methanol over the catalyst in question occurring in accordance with equation (4). In the experiments 3-8 which were performed without a carrier gas or in the atmosphere of nitrogen the ratio of the volumes of hydrogen and carbon monoxide in the gas emitted was close to 2 and their sum amounted to 86-98%. The small amounts of carbon dioxide and methane formed evidently constitute by-products of the gasoline synthesis.

The gasoline obtained from methanol contains a smaller amount of the low boiling (below 150°) components than that obtained under similar conditions from a mixture of 1 volume carbon monoxide with 2 volumes hydrogen over the same catalyst (26.9 and 54.1%, respectively) and it is more abundant in the fraction 150-220° (46.2 and 15.3%, respectively). Only in the atmosphere of hydrogen (experiment 1) gasolines were obtained close in fractional composition. The physical properties and per cent unsaturated of the corresponding fractions are almost identical with the exception of the experiment performed in the atmosphere of hydrogen, in which case the extent of unsaturation of the gasoline is lower.

Experiments with formic acid. The formic acid used was first dried with boric anhydride, which was obtained by igniting boric acid in a platinum crucible. It had a $d(20/4)$ 1.2192 and was 99.1% pure. The experiments were performed in the same way as with methanol. The data in Table 4 referring to experiments 1-4 were obtained with the same portion of the catalyst, while the data of experiments 5-6 with a different portion of the same catalyst simultaneously prepared.

In the calculation of the yield of gasoline in ml. per cu. m. initial gas the latter was understood as the amount of gas which would be obtained under the assumption of complete decomposition of the reacted formic acid according to equations (5) or (6) (2 volumes per each volume formic acid). The composition of the emitted gas shown in Table 5 was obtained after exclusion of the air or nitrogen and after freezing out the condensable constituents. The data reported in Table 6 correspond to those reported for the previous series of experiments in Table 3.

Formic acid is seen from the data of Table 4 to undergo complete decomposition at 180-200°, either by dehydrogenation, (5), or dehydration, (6). The content of carbon dioxide in the emitted gas reaches 55-65% (Table 5). This explains the lower yields of gasoline per cu. m. gas in the case of formic acid (columns 9, Tables 1 and 4) than in the case of methanol decomposing according to equation (4) and giving a gas identical in composition with the starting gas used for the synthesis of gasoline over cobalt as a catalyst.

Determination of formaldehyde in the reaction products showed that decomposition of formic acid as shown in equation (7) is very insignificant and affects 0.1 to 0.5% of the entire initial (or reacted) formic acid. The content of aldehyde in the condensed products (aqueous layer) was determined with hydroxylamine hydrochloride by volumetric analysis of the amount of hydrochloric acid liberated in its reaction with aldehyde:

$$HCOH + NH_2OH \cdot HCl \rightarrow CH_2NOH + H_2O + HCl \quad \ldots\ldots (8)$$

The gasoline from the experiments with formic acid contained a more substantial low boiling fraction than that resulting from experiments with methanol (Table 6). Its content of unsaturated compounds was also larger. The quantity of unsaturated compounds, as well as the amount of the light fraction boiling below 150°, make this gasoline similar to the product of direct conversion of the mixture of 1 mole carbon monoxide with 2 moles hydrogen over the same catalyst.

Ethyl alcohol. Data obtained with ethanol in a preliminary experiment carried out under conditions similar to those employed for conversion of methanol and formic acid follow. The ethyl alcohol used boiled at 78.3° and 760 mm.; $d(20/4)$, 0.7894; $n(20/D)$, 1.3612. The experiment was performed with a fresh portion of the same catalyst for 44 hours at 200°.

A total of 85.0 g. ethanol were passed at a space velocity of 0.036 in the absence of a carrier gas. The products contained 1.5 ml. oil and 5.8 ml. gasoline, a total of 7.3 ml. liquid hydrocarbons. The reaction gases, amounting to 17.9 liters, contained 2.5% carbon dioxide, 2.9% unsaturated hydrocarbons, 9.6% carbon monoxide, 48.3% hydrogen, 27.7% methane and 9.0% ethane.

These data show that ethanol undergoes a series of conversions on the surface of the catalyst and apparently the reaction:

$$CH_3CH_2OH \rightarrow CH_4 + CO + H_2 \quad \ldots (9)$$

is of high significance. It may be assumed that this reaction involves formation of acetaldehyde as an intermediate compound. Ethane may have been formed by dehydration of the alcohol to ethylene, followed by hydrogenation of the latter. The gasoline is apparently formed from carbon monoxide and hydrogen resulting from the decomposition according to equation (9).

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TABLE 6

Expt. No.	Reaction temperature °C.	Fraction with 150° end point: %	d_4^{15}	n_D^{20}	Bromine number	Per cent unsaturated hydrocarbons	Fraction 150-220° C.: %	d_4^{15}	n_D^{0}	Bromine number	Per cent unsaturated hydrocarbons
1	180	41.7	0.6856	1.3899	55.1	32.0	22.5	0.7498	1.4210	12.5	11.6
2	200	68.5	0.6853	1.3891	48.3	28.1	22.2	0.7750	1.4275	8.2	9.1
3	180	58.6	0.6929	1.3923	27.7	17.3	6.9	.....	1.4222	....	....
4	200	65.2	0.6707	1.3827	53.6	28.8	15.2	0.7461	1.4184	10.5	9.8
5	180	38.2	0.6984	1.3956	49.2	30.7	30.9	0.7560	1.4240	10.9	10.6
6	200	53.3	0.6914	1.3946	74.5	46.6	20.0	0.7501	1.4218	24.3	23.6

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TECHNICAL MEETINGS FOR OIL MEN

In response to recent government requests, many technical societies have cancelled or postponed their usual annual and semi-annual meetings. To the extent that we have the information available, the listings below give the meetings which had already been scheduled and their present status.

APRIL

4-6, Amer. Gas Association, Technical Section Conferences, Hotel Stevens, Chicago, **(Cancelled)**

11-13, Natural Gasoline Association of America, 24th Annual Convention, Baker Hotel, Dallas. **(Postponed)**

16-18, Amer. Society of Mechanical Engineers, Spring Meeting, Boston. **(Postponed indefinitely)**

MAY

9-11, Amer. Oil Chemists Society, New Orleans, La. **(Cancelled)**

11-12, Amer. Institute of Chemists, Deshler-Wallick Hotel, Columbus, Ohio.

16-17, Society of Automotive Engineers, Diesel Fuel and Lubricants Meeting, Hotel Carter, Cleveland. **(Cancelled)**

21-23, Amer. Gear Manufacturers Association, The Homestead, Hot Springs, Va. **(Cancelled)**

JUNE

18-21, Amer. Society of Mechanical Engineers, Semi-Annual Meeting, Chicago. **(Postponed)**

18-22, Amer. Society for Testing Materials, 48th Annual Meeting, Hotel Statler, Buffalo.

SEPTEMBER

10-14, Amer. Chemical Society, Annual Fall Meeting, Chicago. (ACS has cancelled its regular Spring meeting.)

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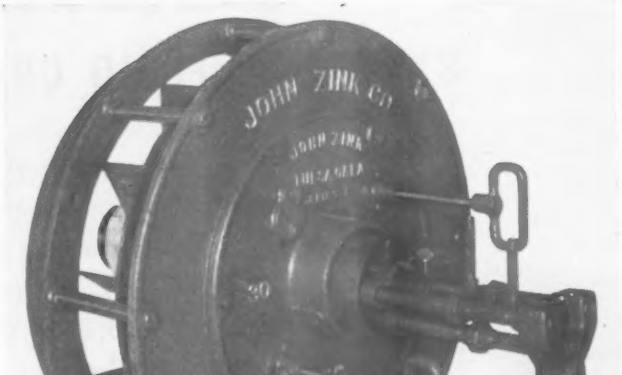

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Catalytic Desulfurization Improves Lead Susceptibility of 'Sour' Distillates

Bureau of Mines Research Indicates that Many Naphthas Produced from High-Sulfur Crudes are Usable in 100-Octane Gasoline

THE problems faced by refiners in handling high-sulfur crudes and products made therefrom have been troublesome for many years. So great have been the economic repercussions of these difficulties that, despite the high demand for crude today, the so-called "sour" crude producers have difficulty in disposing of their product to refineries.

In processing these crudes, refiners have had to overcome two problems: the corrosive effect of the sulfur compounds on processing equipment, and the subsequent treating to reduce the amount of various sulfur compounds in the finished products to meet specification limits for octane number and sulfur content. Both problems, in light of present-day knowledge, require high capital outlay by refiners to insure products which can compete with those obtained from low sulfur crudes.

Experimental test data on desulfurization of virgin light distillates obtained from high-sulfur or "sour" crudes, has been released by the U. S. Bureau of Mines as Report of Investigations 3729: "Effects of Desulfurization on the Lead Susceptibility of Distillates from Some Crude Oils from Texas, New Mexico and Oklahoma," by Boyd Guthrie and M. C. Simmons of the Petroleum Experiment Station, Bartlesville, Okla. The investigations reported were undertaken at the instigation of PAW to determine possibilities of yielding naphthas suitable as base or blending stocks to produce high-octane aviation gasoline. While the data was gathered some time ago its circulation among refiners has been on a restricted basis until recently.

The report as published describes the experimental catalytic desulfurizing procedure, test methods and before-and-after properties of the distillates thus obtained. It also includes a discussion of the depressing effects on octane number and lead susceptibility caused by certain sulfur compounds.

Work on treating "sour" naphthas from other crudes has been going on continuously since this report was completed, it is understood. Some data thus accumulated have been presented in other reports which still are in the "restricted" classification.

The following material is condensed from the present report, R. I. 3729:

Relatively few types of sulfur compounds are normally found in straight-run distillates, compared to the complex hydrocarbon mixture that constitutes the distillate itself, and are generally classified into the following groups: Hydrogen sulfide, mercaptans, disulfides, aliphatic sulfides (which include any saturated cyclic sulfides [thiophanes] if present), and a residual group comprised of any aromatic sulfides or unsaturated cyclic sulfur compounds such as thiophenes.

Elementary sulfur, if present in a distillate, is not a product distilled from the crude oil but results from oxidation of sulfur compounds, generally hydrogen sulfide, in the distillate. With the exception of elementary sulfur, some or all of the aforementioned sulfur compounds, if found in virgin distillates, are generally considered to have been present in the original oil and to have distilled along with the hydrocarbons comprising the distillates, although a few investigators feel that in certain instances some of these compounds are formed during distillation.

The effects of the various sulfur compounds upon both the unleaded and leaded fuels have been investigated extensively in the last few years. Ryan [1], in his investigations of the effects of sulfur compounds upon octane numbers, prepared numerous synthetic blends of pure sulfur compounds and sulfur-free light virgin distillates from Rodessa crude. Additions of 0.05% by weight of either hydrogen sulfide, elementary sulfur, mercaptans, or disulfides, to samples of Rodessa crude distillates resulted in a decrease of somewhat less than one in the octane number of the clear (unleaded) distillate, indicating that the effect of these sulfur groups upon the clear octane number is relatively negligible.

In contrast, investigators have found that these same sulfur compounds markedly depress the leaded octane numbers of a given distillate as compared to the leaded octane numbers of the same distillate free of sulfur. For example, the addition of 4 ml. of lead to a given sulfur-free distillate may increase octane number from 73 to 91. However, if this distillate contains even relatively small quantities of certain sulfur groups, the addition of a similar quantity of lead may increase the octane number to only 86. This effect often is referred to as a depression of lead susceptibility of a fuel, wherein lead susceptibility is regarded as an index of the increase in the octane numbers produced by the addition of lead.

Lead susceptibility usually is expressed in some arbitrary unit, and those to be used in this report, unless otherwise stated, will be values determined from Fig. 1, which was prepared from data published by Hebl, Rendel, and Garton [2] and by Cattaneo and Stanly [3]. In his experiments with a sulfur-free Rodessa distillate, Ryan [1] found that addition of 0.05% by weight of mercaptan sulfur decreased the lead susceptibility from 1.41 to 0.81, or 42%. He further found that the addition of similar quantities of either elementary sulfur, hydrogen sulfide, or disulfide sulfurs to identical samples of Rodessa distillate caused approximately the same decrease in lead susceptibility as followed the addition of mercaptan sulfur.

Using data obtained by Ryan, the Bureau of Mines investigators calculated that the addition of 0.051%, by weight, of aliphatic sulfides to a similar Rodessa distillate would result in a decrease in lead susceptibility of 18.3%. This reduction is equivalent to 43.4% of the reduction caused by the addition of a similar quantity of mercaptan sulfur. Similarly, reduction by the addition of a similar the addition of 0.051% aromatic sulfide sulfur decreased the lead susceptibility only 18% as much as an equivalent amount of mercaptan sulfur. The approximate numerical ratio of the depressing effect on lead susceptibility produced by equivalent amounts of elementary sulfur, hydrogen sulfide, mercaptans, disulfides, aliphatic sulfides, and aromatic sulfides may be expressed as 5:5:5:5:2:1.

Ryan further demonstrated that equivalent weights of polysulfide sulfurs had a more depressing effect upon lead susceptibility than any of the mercaptans or disulfides, and, upon the basis of data obtained in his experiments on the addition of sulfur compounds to sulfur-free Rodessa distillates, developed the following equation for determination of the per cent decrease in lead susceptibility caused by certain sulfur groups:

$$\text{Log}_{10}\, y = 0.949 + 0.36 \log_{10} (2.29\, \textit{polysulfides}) + \textit{RSSR} + \textit{RSR}/2.30 + \textit{ring S}/5.56 \quad \ldots\ldots (1)$$

Where:

y = % decrease in susceptibility,

polysulfides = wt.-% of polysulfide sulfur $\times 10^3$,

RSSR = wt.-% of elementary sulfur, hydrogen sulfide, mercaptan, and disulfide sulfurs $\times 10^3$,

RSR = wt.-% of aliphatic sulfide sulfur $\times 10^3$,

ring S = wt.-% of aromatic and cyclic sulfurs $\times 10^3$.

Sulfur Conversion or Removal Processes

The oldest and probably best-known treating process for the correction of odor, color stability, and corrosive qualities of

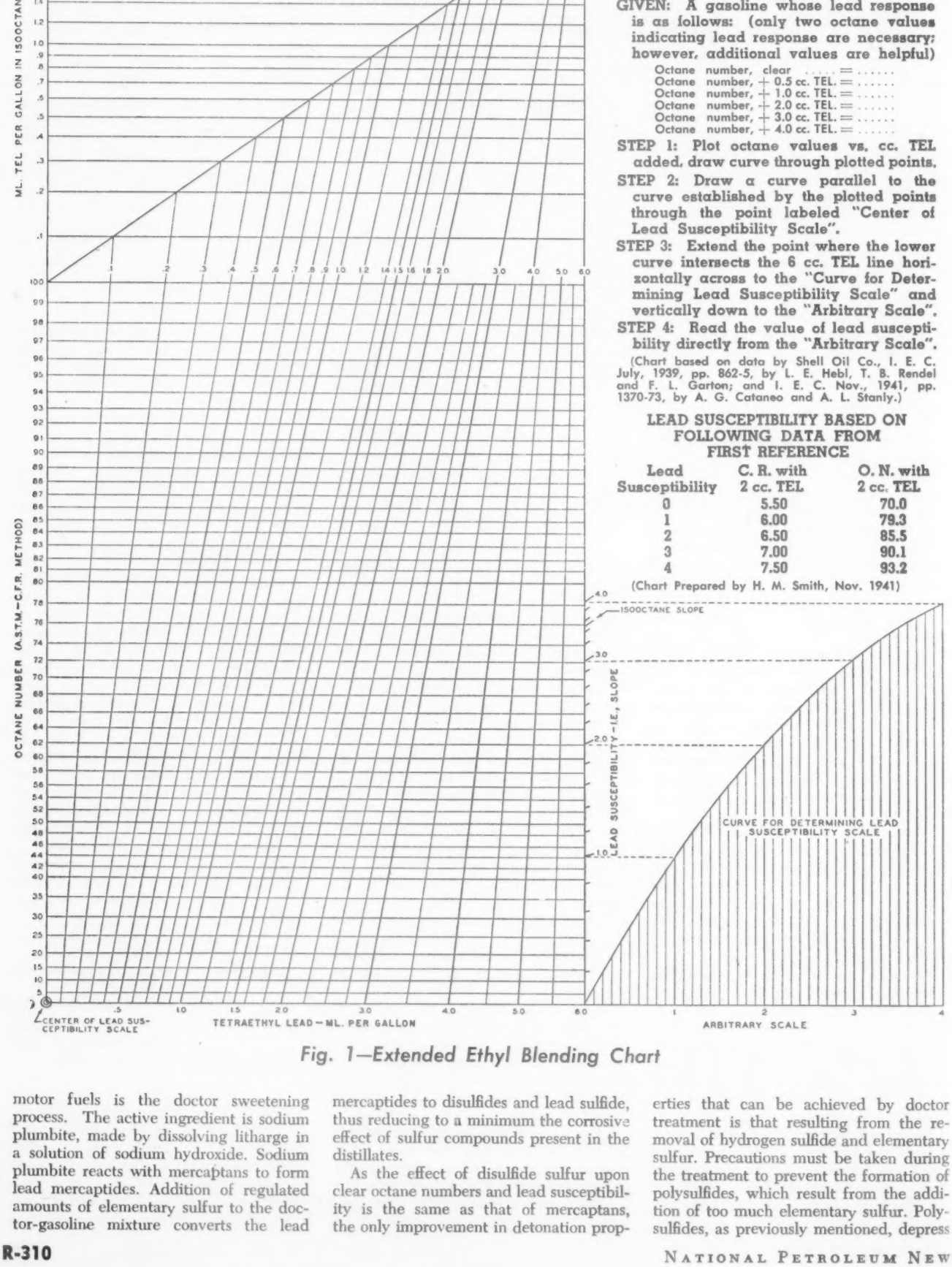
ML. TEL PER GALLON IN ISOOCTANE
OCTANE NUMBER (A.S.T.M.-C.F.R. METHOD)
ISOOCTANE CURVE
EXAMPLES OF PROCEDURE USED TO OBTAIN LEAD SUSCEPTIBILITY VALUES
GIVEN: A gasoline whose lead response is as follows: (only two octane values indicating lead response are necessary; however, additional values are helpful)
Octane number, clear ..... = ...
Octane number, + 0.5 cc. TEL. = ...
Octane number, + 1.0 cc. TEL. = ...
Octane number, + 2.0 cc. TEL. = ...
Octane number, + 3.0 cc. TEL. = ...
Octane number, + 4.0 cc. TEL. = ...
STEP 1: Plot octane values vs. cc. TEL added, draw curve through plotted points.
STEP 2: Draw a curve parallel to the curve established by the plotted points through the point labeled "Center of Lead Susceptibility Scale".
STEP 3: Extend the point where the lower curve intersects the 6 cc. TEL line horizontally across to the "Curve for Determining Lead Susceptibility Scale" and vertically down to the "Arbitrary Scale".
STEP 4: Read the value of lead susceptibility directly from the "Arbitrary Scale".
(Chart based on data by Shell Oil Co., I. E. C. July, 1939, pp. 862-5, by L. E. Hebl, T. B. Rendel and F. L. Garton; and I. E. C. Nov., 1941, pp. 1370-73, by A. G. Cataneo and A. L. Stanly.)
LEAD SUSCEPTIBILITY BASED ON FOLLOWING DATA FROM FIRST REFERENCE
Lead Susceptibility | C. R. with 2 cc. TEL | O. N. with 2 cc. TEL
0 | 5.50 | 70.0
1 | 6.00 | 79.3
2 | 6.50 | 85.5
3 | 7.00 | 90.1
4 | 7.50 | 93.2
(Chart Prepared by H. M. Smith, Nov. 1941)
ISOOCTANE SLOPE
LEAD SUSCEPTIBILITY—I.E., SLOPE
CURVE FOR DETERMINING LEAD SUSCEPTIBILITY SCALE
CENTER OF LEAD SUSCEPTIBILITY SCALE
TETRAETHYL LEAD—ML. PER GALLON
ARBITRARY SCALE

Fig. 1—Extended Ethyl Blending Chart

motor fuels is the doctor sweetening process. The active ingredient is sodium plumbite, made by dissolving litharge in a solution of sodium hydroxide. Sodium plumbite reacts with mercaptans to form lead mercaptides. Addition of regulated amounts of elementary sulfur to the doctor-gasoline mixture converts the lead mercaptides to disulfides and lead sulfide, thus reducing to a minimum the corrosive effect of sulfur compounds present in the distillates.

As the effect of disulfide sulfur upon clear octane numbers and lead susceptibility is the same as that of mercaptans, the only improvement in detonation properties that can be achieved by doctor treatment is that resulting from the removal of hydrogen sulfide and elementary sulfur. Precautions must be taken during the treatment to prevent the formation of polysulfides, which result from the addition of too much elementary sulfur. Polysulfides, as previously mentioned, depress

lead susceptibility more than any other sulfur compound.

More recently developed processes for the correction of corrosion, odor, and color stability in motor fuels involve the use of water-soluble salts of certain metals for oxidizing mercaptans to disulfides in distillates free of elementary sulfur and hydrogen sulfide. These processes use the salts in solution, in the solid state, or impregnated on some inert medium such as clay. Regardless of the form of the salts, the treating processes are essentially the same as far as chemical reactions are concerned—the mercaptans present react with the salts to form disulfides.

Improvements in lead susceptibility by these treating processes theoretically should not be more than the improvement realized by doctor sweetening; yet in practice improvements are often noted, owing primarily to the reduction or elimination of the formation of polysulfides. Precautions must be taken to remove any hydrogen sulfide present in the gasoline to be treated, as it reacts with the salts to form metallic sulfides, which would eliminate the reversible nature of the process. This reversibility is a distinct advantage over the doctor sweetening process because the treating agent can either be continuously rejuvenated or, when spent, removed and reclaimed with comparative ease and reused.

Several processes have been developed for producing doctor-sweet gasoline, based upon the physical extraction of mercaptans rather than their chemical conversion to disulfides. The extraction solutions usually are made by adding certain organic substances to aqueous-caustic solutions. These processes are continuous and fully regenerative and consist of the extraction of the mercaptans with a lean treating solution and subsequent removal of mercaptans from the fat treating solution by suitable stripping methods. As mercaptans and disulfides have approximately the same effect upon lead susceptibility, removal of mercaptans by extraction rather than by chemical conversion to disulfides results in a definite improvement in lead susceptibility.

Sulfuric acid is used extensively in treating light distillates and this may be considered as falling into the category of physical extraction processes for the reduction of total sulfur. It may, under conditions necessary to remove the sulfur to desired limits, react chemically with some of the hydrocarbons present, thereby reducing the octane number of the distillate. This property often offsets its value as a treating agent.

During the past few years several processes utilizing catalysts have been developed for more complete desulfurization of light distillates. In general these processes are based upon the chemical instability of the sulfur compounds present and, either in one or in successive steps in the presence of catalysts, they effect the decomposition of the sulfur compounds into hydrogen sulfide by the application of heat.

One of the processes falling into this general class may be termed hot-earth

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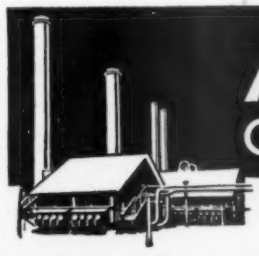

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TABLE I—COMPARISON OF PROPERTIES OF BASE STOCK DISTILLATES BEFORE AND AFTER SULFUR REDUCTION

State Field and County	Per Cent Crude	A.S.T.M. D-86 Distillation 10% evap., °F.	50% evap., °F.	90% evap., °F.	10%—50% evap., °F.	Reid Vapor Pressure, psi	Sulfur wt. —%	Octane Rating (1-C) Clear	Octane Rating (1-C) +4 ml. TEL	Actual Leaded Octane Increase
NEW MEXICO										
Loco Hills (1)*, Eddy	12.5									
Original Distillation		145	172	196	317	6.7	.083	65.5	82.6	
Desulf. Distillation		146	172	197	318	6.6	.001	64.8	88.0	5.4
Cooper-Lynn (2), Lea	8.3									
Original Distillation		145	172	195	317	6.7	.199	64.8	80.1	
Desulf. Distillation		147	173	196	320	7.1	.004	66.5	87.6	7.5
Eunice, Lea	17.5									
Original Distillation		150	198	236	348	7.3	.061	65.9	85.0	
Desulf. Distillation		154	199	236	353	6.8	.003	67.4	88.6	3.6
Hobbs, Lea	19.6									
Original Distillation		155	201	240	356	6.9	.070	<65.0	79.6	
Desulf. Distillation		164	204	242	368	5.6	.002	<65.0	85.6	6.0
Monument, Lea	15.6									
Original Distillation		148	199	240	347	7.5	.047	66.9	85.8	
Desulf. Distillation		156	200	241	356	6.4	.001		90.6	4.8
Mattix, Lea	5.4									
Original Distillation		143	171	193	314	7.2	.138		83.6	
Desulf. Distillation		146	173	194	319	7.0	.002		92.7	9.1
Hardy, Lea	7.3									
Original Distillation		149	178	198	327	7.2	.174		73.7	
Desulf. Distillation		153	179	201	332	6.6	.004		86.6	12.9
Common Stream (3), Lea	12.7									
Original Distillation		142	170	195	312	7.0	.056	66.8	84.2	
Desulf. Distillation		147	171	196	318	6.5	.001	67.3	90.6	6.4
OKLAHOMA										
Healdton, Carter	5.9									
Original Distillation		144	169	192	313	7.1	.016		88.0	
Desulf. Distillation		145	169	192	314	6.9	.000		96.6	8.6
Allen, Pontotoc	10.8									
Original Distillation		201	226	259	427	2.5	.004	74.6	91.4	
Desulf. Distillation						2.4	.000		91.4	0.0
TEXAS										
Noelke, Crockett	9.0									
Original Distillation		143	169	202	312	6.4	.080		81.0	
Desulf. Distillation		143	170	203	313	6.6	.009	<65.0	85.6	4.6
Foster (4), Ector	9.4									
Original Distillation		142	169	199	311	6.8	.144	66.3	80.6	
Desulf. Distillation		143	169	199	312	6.8	.001	67.3	91.9	11.3
North Cowden (5), Ector	12.7									
Original Distillation		143	172	198	315	7.1	.022	<65.0	84.6	
Desulf. Distillation		144	171	197	315	6.8	.001	66.6	89.4	4.8
Goldsmith, Ector	9.7									
Original Distillation		142	165	190	307	7.1	.057		85.0	
Desulf. Distillation		143	165	190	308	7.0	.001	<65.0	88.8	3.8
Wasson, Gaines	20.6									
Original Distillation		150	199	242	349	7.8	.171	<65.0	76.3	
Desulf. Distillation		157	204	243	361	6.7	.003	<65.0	84.7	8.4
Pierce Junction, Harris	5.0									
Original Distillation		194	218	243	412	2.4	.026	68.5	87.5	
Desulf. Distillation		199	221	246	420	2.5	.004	69.8	89.1	1.6
Slaughter (6), Terry	12.0									
Original Distillation		144	169	195	313	7.2	.135	<65.0	80.0	
Desulf. Distillation		145	170	196	315	6.9	.004	65.2	88.6	8.6
Iatan E. Howard (7), Howard	16.7									
Original Distillation		153	199	237	352	6.4	.059	65.7	83.6	
Desulf. Distillation		156	197	233	353	6.1	.001	66.8	89.0	5.4
Yates (8), Pecos										
Original Distillation		146	189	221	335	6.9	.155	66.9	80.4	
Desulf. Distillation		150	191	221	341	6.7	.002	68.1	90.4	10.0
Yates, Pecos	11.2									
Original Distillation		160	213	250	373	6.5	.058	69.7	86.0	
Desulf. Distillation		161	214	250	375	6.2	.003	70.5	92.3	6.3
Big Lake, Reagan	20.5									
Original Distillation		146	204	241	350	7.2	.045	68.2	83.1	
Desulf. Distillation		147	204	243	351	7.0	.003		89.6	6.5
McCamey, Upton	10.7									
Original Distillation		136	199	239	335	7.9	.056	65.7	84.6	
Desulf. Distillation		143	202	241	345	7.0	.002	68.5	90.2	5.6
McCamey, Upton	5.4									
Original Distillation		140	167	195	307	6.7	.035		87.3	
Desulf. Distillation		143	169	193	312	6.4	.003	70.0	93.2	5.9
Payton, Pecos	6.3									
Original Distillation		141	169	191	310	7.2	.060	66.5	86.3	
Desulf. Distillation		146	171	193	317	6.8	.003		90.6	4.3
Henderson, Winkler	12.6									
Original Distillation		161	226	264	387	6.1	.046	69.9	87.9	
Desulf. Distillation		174	227	263	401	5.0	.000	69.3	90.6	2.7

*Numerals indicate that additional data on these samples appears in Table 2.

MAPPING THE BATTLES OF PEACE

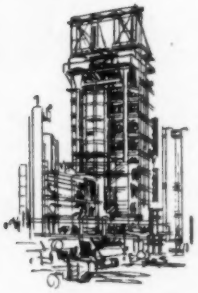

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TABLE 2—COMPARISON OF PREDICTED AND ACTUAL OCTANE VALUES OF DESULFURIZED DISTILLATE

Field	—Loco Hills (1)*— Orig. Dist.	Desulf. Dist.	Cooper-Lynn (2) Orig. Dist.	Desulf. Dist.	Common Stream (3) Orig. Dist.	Desulf. Dist.	——Foster (4)—— Orig. Dist.	Desulf. Dist.
1-C Octane number, clear	65.5	64.8	64.8	66.5	66.8	67.3	66.3	67.3
+ 1 ml. T.E.L.	....	....	....	....	74.8	81.2	....	....
+ 1½ ml. T.E.L.	....	....	....	....	....	....	....	....
+ 2 ml. T.E.L.	....	....	....	....	....	....	....	....
+ 3 ml. T.E.L.	....	....	....	....	82.2	88.0	....	....
+ 4 ml. T.E.L.	82.6	88.0	80.1	87.6	84.2	90.6	80.6	91.9
CFRM Octane number, clear†	66.8	66.1	66.1	67.7	67.9	68.4	67.5	68.4
+ 4 ml. T.E.L.	82.2	87.2	80.0	86.8	83.7	89.6	80.4	90.3
Lead susceptibility‡	1.22	1.98	1.07	1.86	1.36	2.08	0.99	2.22
Actual % decrease		38.3		42.4		34.6		55.3
Group sulfur analysis								
Free sulfur % by weight	0.000		0.000		0.000		0.006	
H_2S % by weight	0.000		0.000		0.000		0.048	
RSH % by weight	0.059		0.063		0.038		0.045	
RSSR % by weight	0.004		0.015		0.002		0.021	
Aliphatic sulfides % by weight	0.018		0.121		0.015		0.015	
Aromatic sulfides % by weight	0.002		0.000		0.000		0.008	
Unaccounted for	0.000		0.000		0.001		0.001	
Calculated % decrease§		40.4		51.4		35.4		51.1
Calculated susceptibility		2.05		2.20		2.11		2.03
Calculated CFRM Octane number		90.2		90.6		90.9		90.4
Calculated 1-C Octane number		89.8		89.6		90.4		89.7

*See designated sample in Table 1 for distillation data.

†All CFRM octane values computed from 1-C octane values.

‡Susceptibility values obtained from chart, Fig. 2.

§Based on group sulfur analysis.

Field	North Cowden (5) Orig. Dist.	Desulf. Dist.	—Slaughter (6)— Orig. Dist.	Desulf. Dist.	Iatan E. Howard (7) Orig. Dist.	Desulf. Dist.	——Yates (8)—— Orig. Dist.	Desulf. Dist.
1-C Octane number, clear	65.0	66.5	64.2	65.2	65.7	66.8	66.9	68.1
+ 1 ml. T.E.L.	....	....	....	....	....	....	....	....
+ 1½ ml. T.E.L.	....	....	....	....	....	....	75.0	....
+ 2 ml. T.E.L.	74.5	....	69.3	80.6	....	....	....	85.3
+ 3 ml. T.E.L.	83.0	....	76.5	87.8	....	....	78.6	....
+ 4 ml. T.E.L.	84.6	89.4	80.0	88.6	83.6	89.0	80.4	90.4
CFRM Octane number, clear†	66.5	67.7	65.5	66.5	67.0	67.9	68.0	69.1
+ 4 ml. T.E.L.	84.1	88.5	79.9	87.7	83.1	88.1	80.3	89.4
Lead susceptibility‡	1.50	1.97	1.09	2.02	1.32	1.90	0.95	1.98
Actual % decrease		23.8		45.5		30.5		52.0
Group sulfur analysis								
Free sulfur % by weight	0.001		0.007		0.010		0.000	
H_2S % by weight	0.000		0.000		0.000		0.000	
RSH % by weight	0.009		0.099		0.025		0.101	
RSSR % by weight	0.002		0.008		0.008		0.009	
Aliphatic sulfides % by weight	0.004		0.011		0.008		0.037	
Aromatic sulfides % by weight	0.005		0.003		0.006		0.006	
Unaccounted for	0.001		0.004		0.002		0.002	
Calculated % decrease§		23.1		49.6		36.7		50.9
Calculated susceptibility		1.95		2.16		2.08		1.93
Calculated CFRM Octane number		88.9		89.5		90.4		90.0
Calculated 1-C Octane number		88.9		88.6		90.1		89.2

(bauxite) catalytic desulfurization, wherein all the sulfur compounds usually found in virgin distillates (with the exception of cyclic compounds) are decomposed and the sulfur converted into hydrogen sulfide. This decomposition is accomplished by vaporizing the distillate, superheating the vapors to 700° F., and passing them through the catalyst chamber at a relatively low pressure. A caustic wash immediately following condensation of the treated vapor is a convenient method of removing the hydrogen sulfide formed.

A distillate thus may be obtained that is relatively free of elementary sulfur, hydrogen sulfide, mercaptans, disulfides, aliphatic sulfides, and aromatic sulfides, with the exception of any cyclic compounds that may be present in either of the last two groups. It will be remembered that saturated cyclic compounds (thiophanes) were included for purposes of analysis with the aliphatic sulfide group, whereas unsaturated cyclic compounds such as thiophenes were grouped with the aromatic sulfides. Thus, hot-earth desulfurization greatly reduces the total sulfur content of the finished product. Sometimes the total sulfur of the desulfurized distillate can be reduced to less than 0.001% by weight.

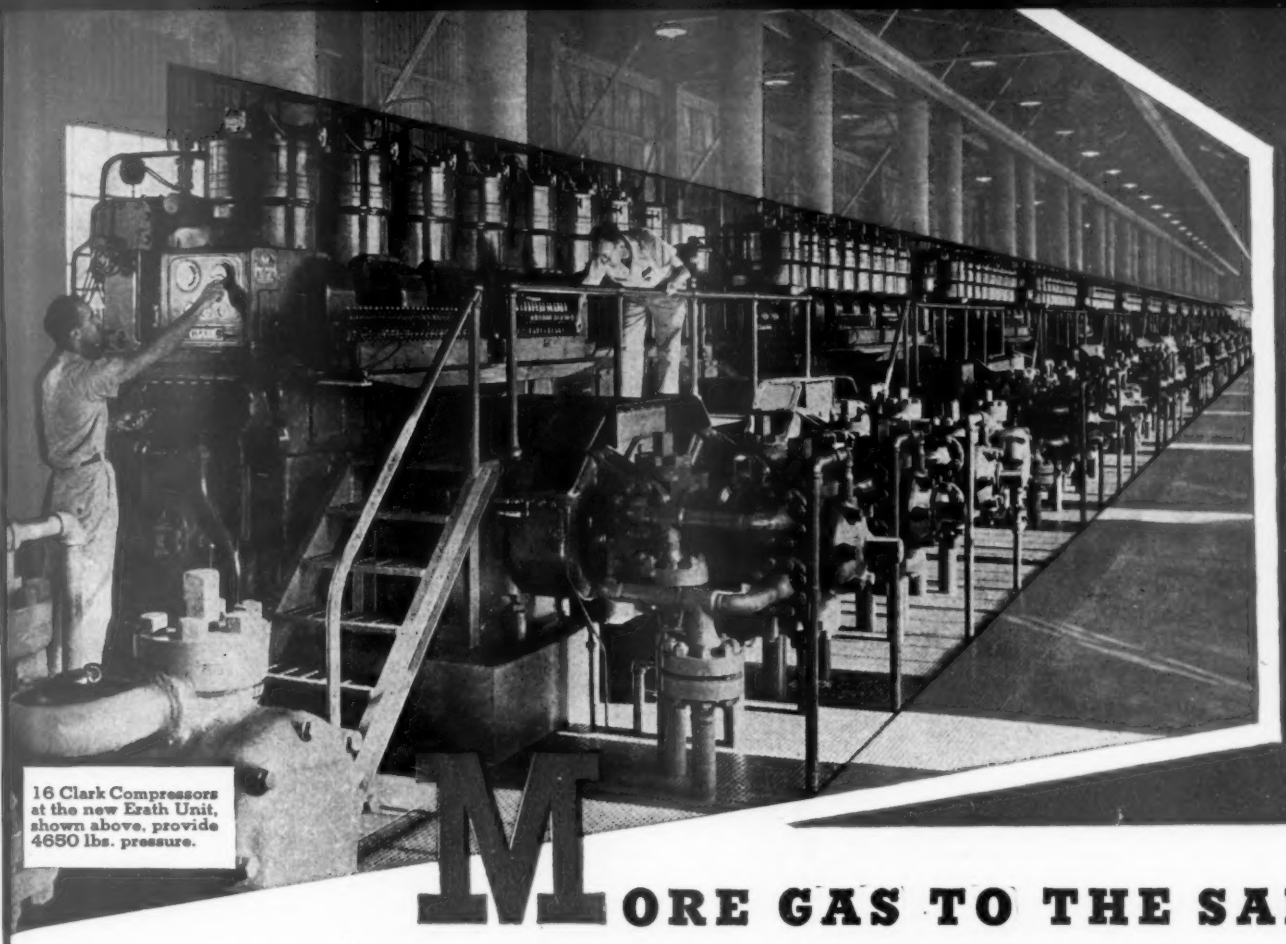
The extent to which cyclic compounds are present is usually indicative of how completely a distillate may be desulfurized by this process. Generally, appreciable amounts of cyclic sulfur compounds are not found in straight-run distillates. Therefore, hot-earth catalytic desulfurization of these distillates usually is very effective.

Pilot Catalytic Desulfurizing

Since the primary object of the investigation was to ascertain the possibilities of utilizing high-sulfur crudes as a source of virgin naphtha aviation base stock, it was necessary to select a suitable desulfurizing process that would reduce to a minimum the sulfur compounds present in the distillate. After considering various treating procedures for the reduction of all types of sulfur compounds in a virgin distillate to a minimum, the investigators concluded that a hot-earth catalytic desulfurizing process would give suitable results upon which to evaluate high-sulfur crude oils as a source of aviation gasoline base stock.

A pilot bauxite desulfurization unit was constructed by members of the Petroleum Experiment Station of the Bureau of Mines at Bartlesville and is illustrated in Fig. 2. The capacity of the unit is one to two liters an hour, based upon a ratio of 1 to 1½ volumes of distillate per unit volume of catalyst per hour. The catalyst used was 14- to 20-mesh Arkansas bauxite. The "sour" gasoline is placed in a screw-cap 2-liter charge bottle. By means of regulated nitrogen pressure, the "sour" charge is forced through a glass orifice at a constant rate to the top of the catalyst chamber, where it is vaporized. A temperature of 700° to 750° F. is maintained in the catalyst chamber by means of two 500-watt nichrome heating coils regulated by voltage regulators.

Temperatures are measured in the catalyst chamber by five thermocouples evenly spaced throughout the length of the chamber. The hot vapors pass down



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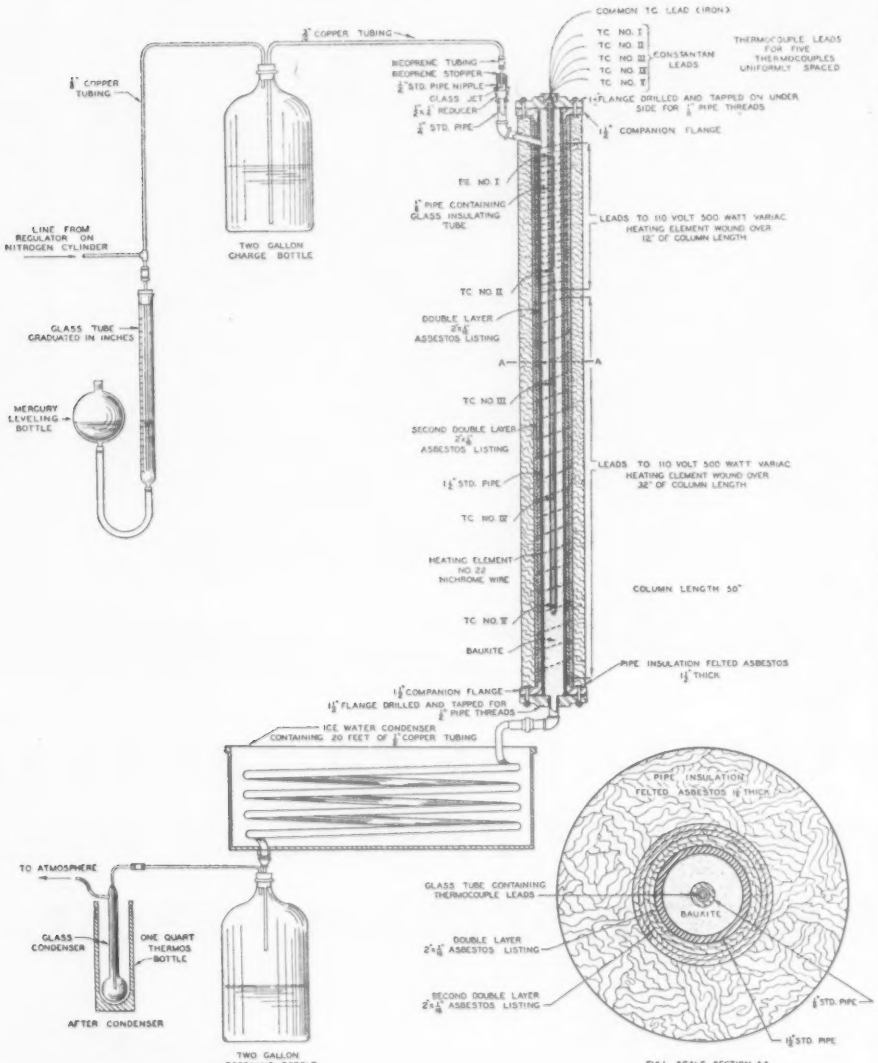
COMMON TC LEAD (IRON)
TC NO. I
TC NO. II
TC NO. III
TC NO. IV
CONSTANTAN LEADS
THERMOCOUPLE LEADS FOR FIVE THERMOCOUPLES UNIFORMLY SPACED
¼" COPPER TUBING
NEOPRENE TUBING
NEOPRENE STOPPER
½" STD. PIPE NIPPLE
GLASS JET
½×¼ REDUCER
¼" STD. PIPE
1½" FLANGE DRILLED AND TAPPED ON UNDER SIDE FOR ½" PIPE THREADS
1½" COMPANION FLANGE
¼" COPPER TUBING
LINE FROM REGULATOR ON NITROGEN CYLINDER
TWO GALLON CHARGE BOTTLE
TC NO. I
½" PIPE CONTAINING GLASS INSULATING TUBE
LEADS TO 110 VOLT 500 WATT VARIAC HEATING ELEMENT WOUND OVER 12" OF COLUMN LENGTH
GLASS TUBE GRADUATED IN INCHES
TC NO. II
DOUBLE LAYER 2"×½" ASBESTOS LISTING
A
A
MERCURY LEVELING BOTTLE
TC NO. III
SECOND DOUBLE LAYER 2"×½" ASBESTOS LISTING
LEADS TO 110 VOLT 500 WATT VARIAC HEATING ELEMENT WOUND OVER 32" OF COLUMN LENGTH
1½" STD. PIPE
TC NO. IV
HEATING ELEMENT NO. 22 NICHROME WIRE
COLUMN LENGTH 50"
TC NO. V
BAUXITE
PIPE INSULATION FELTED ASBESTOS 1½" THICK
1½" COMPANION FLANGE
1½" FLANGE DRILLED AND TAPPED FOR ½" PIPE THREADS
ICE WATER CONDENSER CONTAINING 20 FEET OF ¼" COPPER TUBING
PIPE INSULATION FELTED ASBESTOS 1½" THICK
TO ATMOSPHERE
GLASS CONDENSER
ONE QUART THERMOS BOTTLE
GLASS TUBE CONTAINING THERMOCOUPLE LEADS
BAUXITE
DOUBLE LAYER 2"×½" ASBESTOS LISTING
SECOND DOUBLE LAYER 2"×½" ASBESTOS LISTING
½" STD. PIPE
1½" STD. PIPE
AFTER CONDENSER
TWO GALLON RECEIVING BOTTLE
FULL SCALE SECTION AA ACROSS COLUMN
0 1 2 4 6
SCALE-INCHES
0 1 2
SCALE-INCHES

Fig. 2—Bauxite Catalytic Desulfurizer (capacity—1 to 2 liters per hour)

through the hot catalyst, supported by means of a 30-mesh stainless steel screen, and are condensed in a copper tubing condenser. The treated distillate, cooled by the condenser to 35° to 40° F., is collected over a solution of acidified cadmium sulfate in a 2-gallon receiving bottle jacketed with a bucket of crushed ice. Vapors that are not condensed in the copper-tubing condenser and collected in the receiving bottle are vented through a low-temperature after-condenser of glass submerged in a thermos bottle filled with kerosine and cooled to −20° F. by dry ice. At the end of each run made on the unit, the light distillate collected in the after-condenser is added to the distillate collected in the 2-gallon receiving bottle, so that loss of light vapors during the desulfurization process is reduced to a minimum.

(Note: The laboratory-scale process of catalytic desulfurizing with bauxite described above is an adaptation of a patented commercial process. The equipment, as noted, is constructed of ordinary carbon steel. No corrosive effect from the sulfur compounds present in the "sour" distillates has been noted. One reason advanced for the lack of corrosion is the absence of moisture and salt, considered by some authorities as more to blame for corrosion than the sulfur compounds.—Ed.)

Distillate samples which, exclusive of the effects of their sulfur content, were considered likely sources of base stock either directly or with the addition of filler stocks, were subjected to catalytic desulfurization to ascertain the increase in octane number. Results obtained by the catalytic desulfurization unit are tabulated in Table 1. This data shows each crude oil classified by state, field and county, as well as the percentage of crude oil represented by each distillate. In addition, certain A.S.T.M. D-86 distillation data and the Reid vapor pressures of the distillate both before and after desulfurization are tabulated to show that the hydrocarbon content is not appreciably affected by desulfurization.

Values of total lamp sulfur are given before and after treatment to show the extent of sulfur removal. Values of C.F.R. 1-C octane numbers, where enough distillate was available, and values of C.F.R. 1-C octane numbers plus 4.0 ml. tetraethyl lead are given before and after desulfurization. On an average, the clear C.F.R. 1-C octane number was increased approximately one unit by desulfurization. The octane number of the distillate plus 4.0 ml. tetraethyl lead increased 1 to 13 units, depending on the amounts and types of sulfur present in the original distillate.

Group Sulfur Analysis

Referring to the previous discussion of treating methods, it was brought out that doctor sweetening will remove elementary sulfur and hydrogen sulfide present in a naphtha and convert the mercaptans to disulfides. Therefore, the total percentage of sulfur is reduced only by the amount of elementary sulfur and hydrogen sulfide removed, and any improvement in lead susceptibility or increase in octane number in leaded samples is equivalent to the detrimental effects exerted by their presence. Similarly, any other type of treatment will result only in improving lead susceptibility of a naphtha according to its ability to reduce the sulfur compounds present.

A distillate containing negligible quantities of organic sulfur compounds can be treated satisfactorily by doctor sweetening or the use of water-soluble salts. If the organic sulfur present is largely mercaptans and the quantities of other organic sulfurs are negligible, the distillate can be treated satisfactorily by processes employed for the physical extraction of mercaptans. If, however, the quantities of organic sulfurs other than mercaptans are appreciable, it becomes necessary to use a process such as catalytic desulfurization to reduce the total sulfur to a minimum.

In addition to ascertaining suitable types of treating processes to reduce the sulfur compounds it is important to be able to predict the effects of desulfurization on the increase in octane number of a distillate. This will facilitate selection of the highest end-point distillate that, upon desulfurization, will meet octane requirements, and it will reduce to a minimum the type and amount of desulfurization and test work involved.

Although several systems of group sulfur analysis have been proposed by Faragher, Morrell, and Monroe[4]; Dubrisay[5]; Faragher, Morrell, and Comay[6]; Tamale and Ryland[7]; Ball[8], and others, none have been universally accepted as standard and all are relatively time-consuming and intricate to use. The investigators desiring to expedite their experimental work by devoting as little time as possible to group sulfur analyses and yet obtain suitable results, utilized a procedure adapted mainly from parts of the procedure described by Faragher, Morrell, and Monroe, and by J. S. Ball.

The following procedure proved relatively satisfactory for its intended purpose and consisted of obtaining the percentage of each group of sulfur compounds present by determining the sulfur content of the sample before and after each of a series of extractions carried out in the following order to assure noninterference of one group with the extractions of another:

1. Hydrogen sulfide was precipitated and extracted in the form of cadmium sulfide with acidified cadmium sulfate. Acidifying the cadmium sulfate inhibits the reaction of cadmium sulfate with mercaptans.
2. Mercaptans were then extracted with alcoholic potassium hydroxide, the completeness of the extraction being indicated by the doctor test, which is reported to be sensitive to 0.001% mercaptan sulfur.
3. Elementary sulfur was removed next by agitating the sample in the presence of metallic mercury.
4. After removal of hydrogen sulfide, mercaptans, and elementary sulfur, the disulfides were reduced with zinc and glacial acetic acid to mercaptans, which were then extracted with alcoholic potassium hydroxide.
5. The aliphatic sulfides, if present in the remaining sample, were extracted with mercurous nitrate.
6. The aromatic sulfides were then extracted with mercuric nitrate.
7. Residual sulfur was considered to be the difference between the sum of the percentage of sulfur of all groups and the total original sulfur and largely indicates the completeness of the extractions. Appreciable amounts of residual sulfur may indicate the presence of other sulfur groups that did not receive consideration and if present are considered beyond the scope of this report.

Octane Number Estimation

A modified form of Equation 1 was developed by deleting the term for polysulfides and dividing the RSSR term into its constituent groups:

$$\text{Log}_{10}\ y = 0.949 + 0.36\ \log_{10}\ (S + H_2S + RSH + RSSR + RSR/2.3 + ring\ S/5.56 \quad (2)$$

Where

y = % decrease in susceptibility
S = wt.-% of elementary S $\times 10^3$
H_2S = wt.-% of hydrogen sulfide sulfur $\times 10^3$
RSH = wt.-% of mercaptan sulfur $\times 10^3$
$RSSR$ = wt.-% of disulfide sulfur $\times 10^3$
RSR = wt.-% of aliphatic sulfide sulfur $\times 10^3$
$ring\ S$ = wt.-% of aromatic + cyclic sulfurs $\times 10^3$.

Substituting the data from the group sulfur analysis in Equation 2, the investigators found it possible to predict within desirable limits the amount of increase in lead susceptibility of a distillate after desulfurization. The octane numbers of leaded desulfurized samples can be estimated by the use of the chart in Fig. 1, assuming in each instance that the average increase in the clear octane number on desulfurization is one unit.

Table 2 shows the relative quantity of the various group sulfur compounds present in eight samples, their effect on lead susceptibility, calculated 1-C octane number with 4 ml. tetraethyl lead, and the actual 1-C octane number. It will be seen that except for a reduction in sulfur, no other changes are apparent as a result of desulfurization. The lead susceptibility shown is the computed value, using the chart shown in Fig. 2, as are calculated CFRM octane numbers. The calculated per cent decrease in susceptibility of the sample due to sulfur groups present is based upon substitutions of group sulfur analysis data in Equation 2. Comparison of the actual and calculated octane numbers indicates the degree of accuracy of the method of predicting octane numbers; while a comparison of the actual 1-C numbers of the original sample and desulfurized distillate indicates the degrading effect of the various sulfur groups.

The accuracy of the results that can be obtained by means of Equation 2 is limited by a number of factors, the most important of which probably is the limit of accuracy of the system of group sulfur analysis used. As graphic methods are used to obtain original susceptibility values and predicted octane numbers, the entire procedure cannot be expected to yield results beyond the limits of accuracy of the chart. If only indicative results are required, as in the present instance, Equation 2 can be used effectively to predict leaded octane numbers to within two units of the determined values.

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R-317

Evaporation Losses of Aviation Gasoline In Standing Storage—Part 1

(*Continued from p. R-256*)

temperature alone (assuming an initial temperature of 50° F.) was approximately 1,500 cu. ft., meaning that about 1,500 cu. ft. of gasoline-laden air was expelled from the tank during each period of rising temperature and an equivalent volume of fresh air was drawn in during each period of falling temperature.

It must be remembered, however, that breathing of a tank is not due to temperature variations of gases in the vapor space alone but also is caused by wind velocities, vapor pressure of the liquid surface, and variations in barometric pressure and volume of the liquid due to temperature change.

Under the same conditions the 55,000-bbl., breather-roof tank (Fig. 4), with its roof resting on the supporting framework, would have a vapor space above the gasoline of about 8,000 cu. ft., and for the same daily variation of 40° F. in temperature the increased volume due to temperature rise would be about 600 cu. ft. Since expansion of the roof allows for a vapor expansion of an additional 8,000 cu. ft., it is evident that more than enough additional space is available to take care of all breathing due to temperature changes of the gas in the vapor space.

Auxiliary equipment on the roof of the tank used in Tests B and C (Fig. 4) was the same as on tank A.

As the roof is constructed of 3/16-in. steel plates weighing 0.85 oz. per sq. in., and the pressure- and vacuum-relief valves in the vent unit were adjusted to open at a pressure of 0.5 oz. per sq. in. above and below atmospheric pressure, it is apparent that normally there was no expansion of the roof. However, during rapid vapor expansion the capacity of the vent valve was exceeded, and flexing of the roof provided the necessary additional vapor space. The entire surfaces of the tanks were painted white for maximum heat reflection.

The evaporation-loss results obtained from Tests B and C are shown in curves B and C (Fig. 3). These losses were measured by the method described under Test A. The tanks contained blended aviation gasoline, Tank B having an initial gage of 52,032 bbls. at 60° F. and tank C 51,702 bbls. at 60° F.

Tests on tank B, which were continued from April 15, 1942, to July 29, 1942, indicated a total loss of 63 bbls. or 0.12% of the original contents of the tank, at the rate of approximately 18 bbls. or 0.04% per month. This evaporation rate remained fairly constant during the entire test period, but application of a water spray on the tank deck from June 24 to July 29 prevented an increase in the rate of evaporation, such as occurred in tank A owing to the increased atmospheric temperatures.

The total loss indicated by the test on tank C from Feb. 18, 1942, to July 10, 1942, was 184 bbls. or 0.36% of the original contents of the tank. The rate of evaporation was approximately 50 bbls. (0.10%) per month. Apparently the amount of loss indicated by the second point (79 bbls., March 18) on curve C is in error because the rate of loss would not be expected to be greater during cooler weather than during succeeding warmer weather.

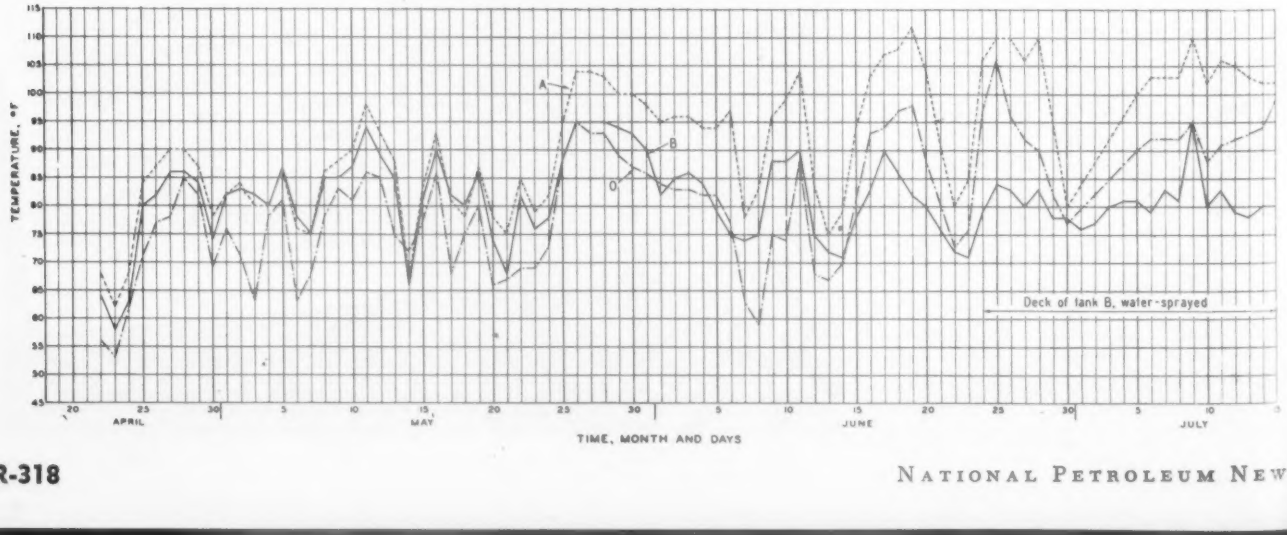
Results of laboratory tests on samples of the stored gasoline taken at the beginning and end of the tests of tanks B and C are reported in Table 3. These include the same determinations reported under test tank A, but not determinations on tetraethyl-lead concentrations because none of this material was blended into the fuel. Results from test tank B over the entire test period indicate a slight decrease in gravity from 72.9° to 72.4° A.P.I. and increases of 4°, 2°, and 2° F. of temperature on the first three distillation points, respectively. Results from test tank C also show a slight decrease of gravity from 74.2° to 73.6° A.P.I. and slight temperature increases of 1°, 2°, and 1° F. on the first three distillation points, respectively. These changes probably are insufficient to affect the characteristics of the fuels. Other minor changes in the fuels in test tanks B and C, Table 3, are within the limits of laboratory accuracy.

The maximum atmospheric tempera-

TABLE 3—Laboratory Analyses of Aviation Gasoline Samples Obtained at Beginning and End of Test Periods on Tank B and C

Test	Tank B		Tank C	
Date sampled	April 15, 1942	July 15, 1942	Feb. 18, 1942	June 17, 1942
Specific gravity at 60° F.	0.6922	0.6940	0.6880	0.6900
A.P.I. gravity at 60° F.	72.9	72.4	74.2	73.6
Reid vapor pressure, psi	7.0	7.0	6.8	6.8
Octane No. (A.F.D.-1-C) clear	79.5	80.1	83.2	83.5
Sulfur content, %	.004	.005	.004	.005
Color, Saybolt	30+	30+	30+	30+
Corrosion (copper-dish)	Neg.	Neg.	Neg.	Neg.
A.S.T.M. Distillation, D-86				
F. D., °F.	116	120	118	119
10%, °F.	140	142	138	140
20%, °F.	147	149	146	147
30%, °F.	154	154	153	153
40%, °F.	161	162	161	162
50%, °F.	170	170	171	172
60%, °F.	181	181	187	188
70%, °F.	197	196	208	210
80%, °F.	217	217	232	232
90%, °F.	244	242	263	264
E. P., °F.	352	348	361	363
Recovery, %	97.4	98.2	98.0	98.0
Residue, %	1.2	1.0	.7	.9
Loss, %	1.4	.8	1.3	1.1

Fig. 5—Daily maximum temperatures recorded of vapors in storage tanks A and B, and of Atmosphere (O) from April 22 to July 15, 1942



tures and the maximum vapor temperatures in tanks A and B for the warmer months of the test period (April 22 to July 15, 1942) are shown in Fig. 5. The value of the water spray on tank B is clearly shown. For example, the water spray was in operation on tank B from June 24 to July 15, and during this period the average maximum vapor temperature in tank B was 80° F. compared with the average maximum vapor temperature of 101° F. in tank A (non-sprayed). The maximum vapor temperatures for July 9 were not included in this average, as the spray was not operating that day. All during the period June 24 to July 15 the maximum vapor temperature in tank B was below the maximum temperature of the atmosphere.

During wet weather the vapor temperatures in this tank equipped with the breather roof were below the maximum atmospheric temperatures because the rain collected on the breather roof when in the deflated position, cooling the vapor space.

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R-319

WIDENING HORIZONS

Views on Personnel, Management and Economic as Well as Technological Developments in Petroleum Refining and Natural Gas Processing: Comment from Readers Is Invited

Research, or Medicine Show, on an Automotive Development

THE injection of an alcohol-water mixture in gasoline engines as a means of increasing their power has been a widely discussed subject among oil company technologists since it was presented in a paper at the recent S.A.E. meeting in Detroit. (*See pg. R-249 of this issue*).

The principle of injecting some supplementary material into the fuel under closely controlled conditions, as a detonation depressor or internal coolant, seems to be recognized as having possibilities for improving engine performance. There is divergence of opinion, however, as to whether water alone won't serve the same purpose as an alcohol-water mixture, the alcohol serving only to keep the mixture from freezing. Other materials may serve even better than water or alcohol, it is suggested by some. Other points are raised on which it is felt that more study is warranted on the principle itself; aside from those having to do with providing a simple apparatus for automatically controlling the injection, foolproof enough for installation on all makes and types of cars and trucks.

In view of the many points raised, it is understood that the Co-operative Fuels Research Committee of the Co-ordinating Research Council has decided to set up alcohol-water injection as a project for early study. This would be a logical part of the general study of the use of alcohol in internal combustion engines which the CRC is now organizing.

Such a proposal insures that the subject will have careful and unbiased study by the best informed group of fuel technologists in both the automotive and petroleum industries. The group will also have at its disposal the experience and data and laboratory facilities of many oil and automotive companies.

The Co-ordinating Research Council, while it has been in existence for many years, has conducted its work without much fanfare of publicity. Consequently the CRC and its work are not as well known among oil company executives as they should be. Sponsored by the automotive industry through the S.A.E., and the petroleum industry through the A.P.I., it co-ordinates the engineering interest in the two industries in developing the best combinations of fuels, lubricants and equipment.

This approach of the technologists of the CRC group towards the use of alcohol as a fuel or as supplementary to the fuel through injection into the engine is about at the extreme from that displayed by William J. Hale, research chemist for the Dow Chemical Co. as expressed at a recent public address in Cleveland. Dr. Hale has long been an ardent proponent of power alcohol, by subsidy if it cannot stand on its own feet in competition with other fuels. He made the following flat statement:

"Gasoline is the worst fuel for automobiles. However, mixed with alcohol, mileage is stepped up enormously." The injection of alcohol and water into the engine he called "the biggest step forward in automotive engineering in years."

Warming to his subject Dr. Hale painted a picture of the coming era of farm chemurgy in such glowing terms as would have done justice to the wagon tail board lecturer of 50 years ago. "Heaven speed the day," he said, "when every block of coal and every gallon of petroleum is gone. We don't need them. We can make everything we need from sunlight."

Technologists Have Important Role in Postwar Refining

THE technologists in petroleum refining whose achievements have been a most vital contribution to the nation's wartime program face many new problems in the reconversion period. An overriding factor in all the consideration of this subject is the shortage of technical manpower, which will necessitate a closer tie-in and co-ordination of the work of the research and development departments with that of the operating department, to stimulate the application of the wartime techniques to postwar activities.

In the coming competitive period, the technologists for the individual oil companies will be on their own again. The oil companies will not feel free, nor will they desire, to continue the co-operation and trading of information which existed in the wartime period, even though it greatly stimulated improvements in refining practice.

In the postwar competitive period, costs will again become the dominating factor in the individual company's operations. The wartime operations of necessity have not provided the most efficient utilization of refining facilities. The catalytic cracking units and other intricate processes which were installed to produce the maximum amounts of 100-octane gasoline must be altered and where possible co-ordinated to produce maximum yields of motor fuel, to sell at probably less than half the refiner's wartime return from aviation gasoline. Those facilities which cannot be economically operated to produce motor fuel must be reviewed to see whether they can be used to make some other product.

Unless improved techniques for locating new oil fields are discovered, new production will be more costly to oil companies than in the past and, in a competitive period, refiners may be forced to pay higher prices for their crude. This factor, together with the intricate nature of the processes installed, will make it important to study intensively the nature of the raw materials available to the company—crude, natural gas and any others. Such investigations will bring out what products the company's plants can most efficiently manufacture.

In connection with the consideration of motor fuel demand, in the light of present conditions it is possible the industry may have to revise upwards its postwar estimates. It has been recognized that there would be a continuing demand from military sources but it was assumed there would be a considerable drop in civilian demand pending the building of new cars. It now seems apparent that fewer cars are being scrapped than had been previously estimated based on past experience.

In the reconversion period just as much as during wartimes the technologists will be a most important factor to the profitable operations of their companies. The companies in many instances are recognizing this fact by giving more voice in management to this group of men.

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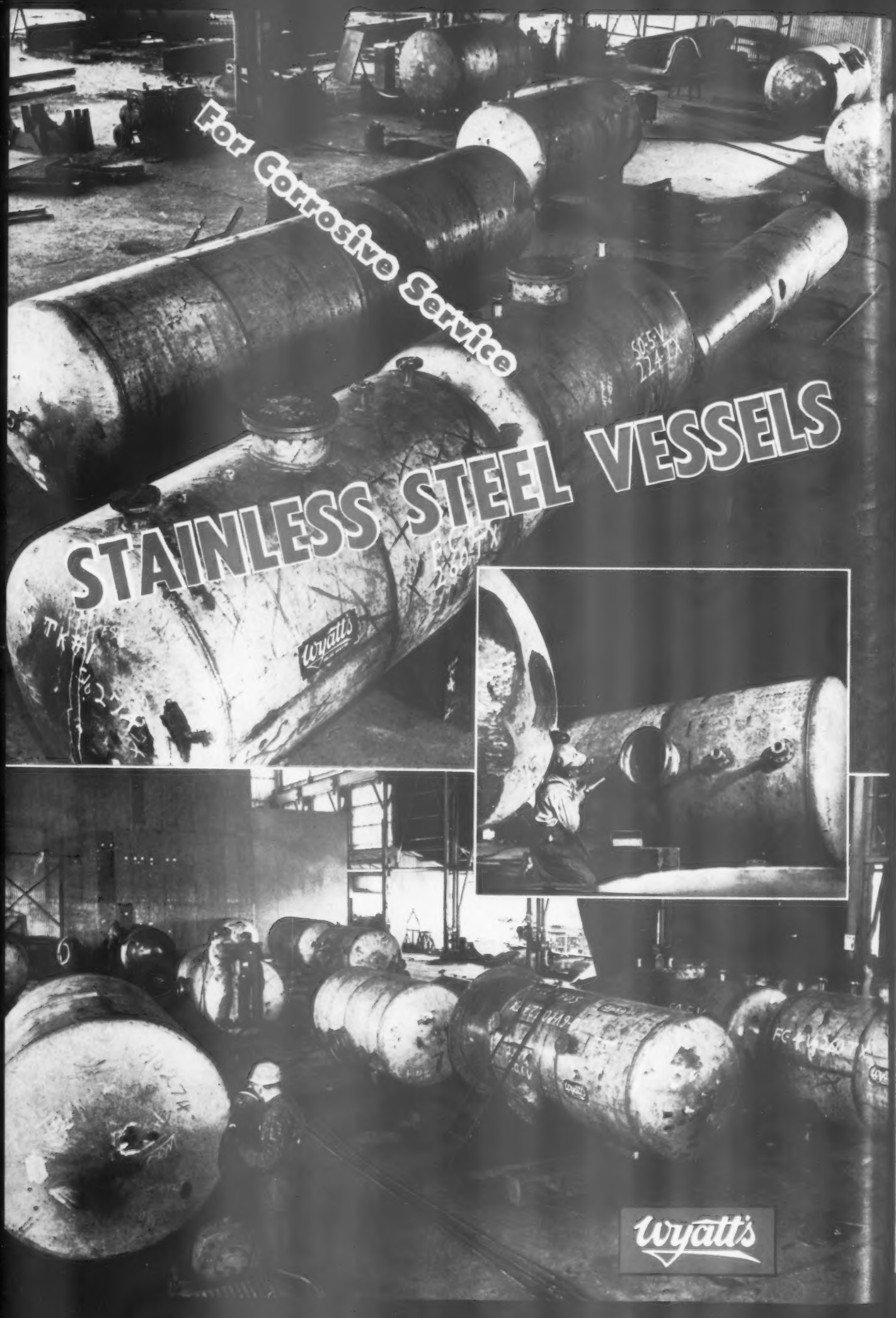
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